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Cooperative Localization with TOA Technique

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Abstract

Localization Concept Majorly Used in WSN.In this paper there is a concept of Cooperative Localization Has been introduced. From which we can able to find the position of unknown nodes. Also there is a several techniques of finding Cooperative Localization. Here Time of Arrival Technique has been introduced and founded an unknown position of nodes.

Keywords: *TOA, Cooperative Localization, Self-Localization*

1. Introduction

Localization of nodes in wireless networks is required in various applications. In many scenarios, it is important for the nodes to know their own position and the position of other nodes in the network. As an example, the first responder situation considered in benefits from self-localization and localization of other members by each member of the team.

Research done to address the above issues provides a variety of practical techniques. Extensive surveys of such techniques are provided. In time-of-arrival (TOA)-based systems, in particular, measuring time delays with the knowledge of anchor positions provides localization. The common challenges in location estimation are measurement noise, availability of accurate timing models and anchor uncertainty. Authors in have proposed estimation methods and algorithms which are robust to anchor and timing uncertainty.

Cooperation between the nodes is used in position estimation solutions. A distributed localization method is presented which is based on factor graphs and relies on cooperation and message-passing between nodes. The method enables accurate and robust localization in networks which are not fully connected and its performance is studied in a numerical simulation scenario based on experimental measurements. Here, a cooperative localization algorithm is derived, which extends the non-parametric belief propagation (NBP) message-passing method first introduced in. The method, which is based on approximating the junction-tree, improves performance with a reduced number of particles with respect to other NBP algorithms in the literature. The algorithm is validated by simulation and by applying it to experimental indoor ranging data.

2. Cooperative Localization with TOA

The network localization generally consists of two phases, namely the measurement phase and the location estimation phase. Most sensor network localization algorithms rely on measurements between neighbouring sensor nodes for location estimation. Packets are exchanged between neighbouring nodes in the network in the measurement phase. The receiver node can extract information regarding distance or bearing by measuring or estimating one or more signal metrics from the physical waveforms corresponding to these packets.

In the location estimation phase, measurements are aggregated and used as inputs to a localization algorithm. In this section, first we describe the distinction between non-cooperative and cooperative localization algorithms. Then, we explain the localizability issue arising within the cooperative localization and elaborate the graphical issues in the localizability problem.

2.1 Non-Cooperative vs. Cooperative

In a non-cooperative (one-hop) localization approach, there is no communication between ordinary nodes, only between ordinary nodes and anchors. Every ordinary node needs to communicate with multiple anchors, requiring either a high density of anchors or long-range anchor transmissions as shown in Figure 1.

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In cooperative (multihop) localization, we still allow ordinary nodes to make measurements with anchors, but in cooperative localization, we additionally allow ordinary nodes to make measurements with other ordinary nodes as shown in Figure 2. Internode communication removes the need for all nodes to be within communication range of multiple anchors. Thus, high anchor density or long-range anchor transmissions are no longer required. The additional information gained from these measurements between pairs of ordinary nodes can offer increased accuracy and coverage.

2.2 TOA Technique

The distance between the transmitter and the receiver may be estimated based on the speed of the wave propagation and the measured time for a radio signal to travel between two sensor nodes. The method may be applied to many different signals, such as RF, acoustic, infrared and ultrasound. The implementation of the technique depends on the measurement of time of arrival (ToA). The ToA may be measured with some advanced timing techniques.

3. Figures

3.1 Figures

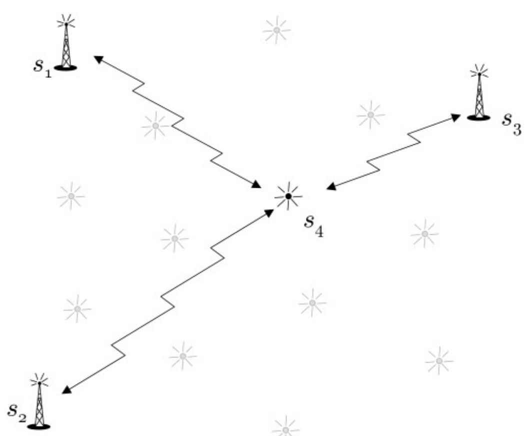

Fig. 1 Non-Cooperative Localization

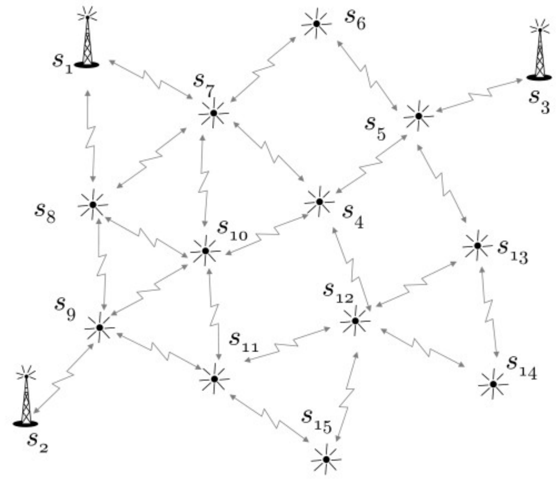

Fig.2 Cooperative Localization

4. Conclusion

In this paper, the use of different localization algorithms when performing sequential wireless sensor network discovery has been investigated. This discovery process is employed to estimate the location of a large number of low powered nodes in a distributed fashion such that when a node location has been estimated, it may be used to localize other nodes. The localization algorithm employed is central to the performance of this process. Range based (i.e. TOA, TDOA and RSS), direction based (i.e. DOA) and hybrid (i.e. LAA) localization algorithms were considered and it was shown that DOA is the preferred scheme at low SNR and the LAA localization algorithm provides better performance for network discovery at higher SNR.
ToA offers a high level of accuracy, but also requires relatively fast processing capabilities in sensor nodes to resolve many timing differences for fine-grained measurements.

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