Impact of Mobility of Anchor Nodes in Localization and Tracking of Multiple Mobile Nodes

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***Abstract*—Fishermen at sea lack proper localization and tracking systems leading to increased loss of life at sea due to disasters, engine failure, and collision with ships. To reduce the impact of such scenarios we need an efficient localization and tracking algorithm for approximate localization of fishing vessels in a spatio – temporal domain. In this work, we have analyzed few existing algorithms for localization of mobile sensor nodes and based on these results, an Enhanced Chord Based Localization Algorithm (ECLA) has been designed and developed. The proposed algorithm is implemented and extensively tested on the basis of different performance parameters such as mobility, localization accuracy, execution time etc. The experimental results clearly show that the proposed algorithm has better localization accuracy compared to the existing localization algorithms. The accuracy of the proposed ECLA algorithm is 26.5% better than that of Monte Carlo Boxed (MCB) localization scheme**.

Keywords-Localization; Tracking; Mobility of Anchor Nodes; Mobile Sensor network; Wireless; Sensor Network

I. INTRODUCTION

Most of the applications in Wireless Sensor Networks (WSN) require the knowledge about precise location of sensor nodes. Location information is typically used for applications such as location services, rescue operations, routing, and target tracking [1]. Global positioning system (GPS) is a widely used localization system with higher accuracy for outdoor applications. As the size of sensor network becomes larger, it will not be an affordable solution for localization since the cost of each GPS device is in the range of 10000-20000 rupees.

The Indian coastal region lacks proper search and rescue operation for fishing vessels due to the non-availability of proper real-time localization and tracking of the vessels and communication systems. Currently beyond 15km, the fishing vessels lack proper communication to the shore and also the communication between the vessels. Hence a new communication system is proposed in a research project MICRONet [10]. This architecture uses opportunistic communication technology to provide connectivity to the fisherman. Even with the connectivity, real-time localization of the fishing vessels is one of the major research challenges since all fishing vessels do not have GPS device due to its high purchase cost. The other major research challenges in this scenario includes the unknown mobility pattern, no predefined path for the fishing vessels, the spatio-temporal variation in the paths based on the availability of fish, intermittent connectivity, mobility of all fishing vessels including anchor nodes, the spatio-temporal variation in the availability of the anchor nodes, and the signal quality variation due to the propagation and noise effects on the wireless channels. This makes it more challenging to develop an affordable real-time localization and tracking solution with minimum error for our scenario.

For the purpose of designing and developing an efficient localization and tracking system for marine environment, we have analyzed the different existing localization methods for mobile sensor network based on our communication architecture. Based on the results from this analysis, we have proposed and developed an Enhanced Chord Based Localization Algorithm (ECLA). We have simulated this algorithm for different number of anchor nodes and normal sensor nodes and the results clearly show that mobility of anchor nodes has an impact in localization and tracking of fishing vessels and ECLA performs better than the existing solutions.

The rest of this paper is sectioned as follows: The related work of the localization schemes is shown in Section 2. We describe the architecture of offshore communication system in Section 3. The enhanced chord based algorithm is detailed in Section 4. Section 5 describes the mathematical modelling. Section 6 provides the experimentation results and the inferences for the existing and proposed algorithms. Section 7 concludes the paper.

II. RELATED WORK

Localization algorithms are generally developed for static networks. Multi-Dimensional Scaling (MDS), DV-Hop, and Centroid localization schemes are designed for localization and tracking for applications that uses static sensor network. However these schemes are not designed for mobile networks and no one has yet studied about the amount of localization error if these schemes could be adapted for mobile sensor network.

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