ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 3, Issue 2 , February 2016

A Novel Range-Free Prediction Based Beacon Localization Protocol for Mobile Sensor Networks

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ABSTRACT: Location awareness has become an significant feature for many wireless sensor network (WSN) applications. Examples of such kind of applications include position tracking, mapping, location-aided routing, and others. Information about the position of devices is very valuable in many applications. People, animals, robots and sensors are some examples of entities that have been targeted as sensor nodes of interest for localization purposes. Due to cost and energy constraints, not all nodes may have a consistent source of location information. There are many techniques in the literature proposed for static and mobile sensor networks. A significant amount of localization algorithms have been developed to localize nodes by sharing information with anchor nodes. However, energy efficiency becomes a critical issue for localization in mobile sensor networks due to sparse anchor node problem or high communication cost. All existing localization methods try to localize more nodes in a routing network without guarantee of localizing all nodes. They usually assume that there are sufficient anchor nodes to achieve the goal, or the set of anchor nodes are pre-decided before deployment of the network. However, in this project we propose a novel range-free localization prediction beacon localization protocol (RPBLP) based on duty cycle in target tracking application. RPBLP aims to localize all sensors in a network using the least number (or total cost) of dynamic anchor nodes given the tracking performance i.ea dynamic anchor nodes selection procedure is also devised to further improve localization accuracy of target. Extensive simulations have been conducted and demonstrate the efficiency of our algorithms.

KEYWORDS:Range-free, localization, ad-hoc network, Mobile sensor network.

I. INTRODUCTION

The design of wireless sensor networks (WSN) depends on the application requirements. Such as environmental monitoring is an application where a region is sensed by numerous sensors and the data are gathered at a base station where additional processing can be performed. The sensors for such kind applications are usually intended to work in conditions where it may not be possible to replace the batteries of the nodes. This means that energy rate is a very precious resource for sensors, and communication traffic overhead is to be minimized. Such constraints make the design of data communication protocols a demanding task. A sensor network is a network of many tiny disposable low power sensors, called nodes, which are spatially circulated in order to perform an application-oriented global job. These sensor nodes form routing network by communicating with each other nodes either directly or through other sensor nodes. One or more sensor nodes among them will serve as sink node that are capable of communicating with the other nodes either directly or through the existing wired networks. The most important component of the network is the sensor node, essential for monitoring real/physical conditions such as temperature, humidity, pressure, vibration, intensity, motion, pollutants etc. at different locations. The sensor nodes, which consist of sensing area, on board processor for data processing, and communicating machinery, leverage the idea of sensor networks based on collaborative effort of a large number of nodes.

II. RELATED WORK

Location awareness plays a vital role in mobile sensor network. The process of finding accurate location between the nodes will tends to use many types of localization process but it leads to high communication problem and sparse anchor node. Therefore they initialize historical beacons and received signal strength (RSS).The goal of a beacon is to make an announcement to anchor node in previous time slot and RSS is used for calculating the constrained region. Thus, the above process minimizes the power wastage that is necessary in case of high communication.

LjubicaBlazevic et al.[1] specified the combination of location-based routing and link state routing to achieve the scalability process in large mobile ad hoc networks. If the nodes and holes cause high mobility, in order to save battery the nodes frequently gets disconnected. In that case, the location-based routing is used as Terminode Remote Routing (TRR) and link state routing is used as Terminode Local Routing (TLR). TRR is used when the destination between the nodes is far and TLR is used when the destination between the nodes is closer.

HarshaChenji et al.[2]proposed a FUZLOC, the fuzzy logic-based localization method, it involves the process of finding accurate location in a noisy and harsh environment. FUZLOC consists of two types of constituent system such as fuzzy multilateration and grid predictor. The as fuzzy multilateration is used for localization process whereas grid predictor is used in anchor node for sparse network. In order to decrease the localization error more number of anchor nodes is deployed and it slightly increases the storage requirement.

Anushiya A Kannan et al.[3] proposed simulated annealing technique to reduce flip ambiguity problem that causes larger errors in location estimation and it is a major problem in wireless sensor network. Simulated annealing technique is used to calculate the accurate location between the nodes, and the optimization is used to some nodes that have flip ambiguity problem. The flip ambiguity problem is identified with the help of neighbourhood information of nodes and is used, in a sensor network having medium and high node density and for low density it will maintain the required neighborhood information of nodes, after identifying flip ambiguity problem the node is moved to the correct position. In addition it gives a better accuracy in localization process.

KiranYedavalli et al.[4] proposed SBL (sequence based localization), a simple and novel based localization process, and it use location sequences to identify distinct regions in the localization space. The location between unknown node and the reference nodes is estimated sequence using RSS measurements of RF signals using the predetermined list of all feasible location sequence, called the location sequence table. Both SBL to RF channel achieve the robustness in distance estimation process.

Yi Zou et al.[5] proposed virtual force algorithm (VFA) to increase the sensor network coverage area in larger extend. Thegiven number of sensors is randomly deployed in the sensor network to maximize the sensor field coverage, the VFA algorithm uses the force-directed approach that attempts to determine virtual motion paths and the rate of movement for the randomly-placed sensors using the combination of attractive and repulsive forces between the nodes. The sensor positions are identified, and redeployed to these positions with the help of energy consideration incorporated**.** VFA algorithm ensures flexibility, computation time and a one-time repositioning of the sensors.

Sung-Hwa Hong et al.[6] proposed a localization algorithm that helps to estimate the position of nodes. The nodes are sensor and it continuously move, along with the sensor node such as travelling nodes, anchor nodes and gate node are also moved because each of them attached with each other. It is also used to calculate indefinite travelling direction arises between the nodes.

III. LOCALIZATION APPROACHES

Many localization algorithms have been proposed over the past few years. Localization approaches for WSNs can be divided into two main categories. Range-based techniques require special hardware for estimating the distance between anchors and regular nodes, which may become prohibitively expensive. Range-free techniques, on the other hand, do not impose such demand as an anchor informs other nodes about its own position through message passing. After finishing the distance-from-anchor estimation process, a regular node can determine its own position through a variety of methods, such as multilateration, and triangulation. If necessary, an optional step is performed, in which regular nodes exchange messages among themselves to refine their locations.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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PriorRange-Free LocalizationAlgorithms

In subsequent discussion, each anchor node sends a beacon (which carries its location information) to its one-hop neighbors (called one-hop-beacon-broadcasting) or its one-hop and two-hop neighbors (called two-hop-beacon broadcasting) or all nodes. Normal node collects beacons from anchor nodes to determine its location.

Monte Carlo Localization (MCL) is the methods used in robotics to locate a mobile robot. In MCL the filtering occurs by using the position information obtained from both the one-hop and two-hop anchors. The one-hop-anchor group is composed of the anchors the sensor node heard directly. These anchors are assumed to be in the radio range r of the sensor node. The two-hop-anchor group is composed of anchors the sensor node did not hear itself but its one-hop neighbors did. These anchors are assumed to be in the range 2r of the sensor node but not within a radius r. In other words, MCL makes use of negative information. Note that this usually leads to improved localization accuracy in an obstacle-free deployment area but is quite risky otherwise.

Monte Carlo Localization Boxed is despite being quite accurate, especially in low-anchor configurations. MCB uses steps similar to those of MCL. The original MCL algorithm uses information about one-hop and two-hop anchors at filtering time only, for rejecting impossible location samples. In MCB, we use the information about the anchors heard to constrain the area from which the location samples are drawn. Namely, we constrain the area from which samples are drawn by building a box that covers the region where anchors' radio ranges overlap.Most importantly, it ensures that a node having heard anchors will be localized and it will not pay a high price in term of processing time and energy expenditure because of the inefficiency of the localization algorithm.

Further, there is a refinement of the MSL algorithm, named the **Improved Monte Carlo Localization (IMCL) algorithm**. The IMCL algorithm divides the communication region of normal node into eight sectors of equal size, and extends the radius of each sector to the maximal distance from normal node to the valid location samples within the sector. In the IMCL algorithm, a sample is considered valid (invalid) for normal node, if it is inside (outside) the intersection of the anchor-constrained region of normal node and all neighbor constrained regions of the one-hop neighboring normal nodes of normal node.

The challenges are However, when the anchor density is high, the MCB algorithm may generate much more valid location samples than necessary for estimating the location of normal nodes. Although the MSL algorithm can estimate the location of normal node more accurate than the MCB and MCL algorithms, it incurs higher communication costs at the same time. However, it is not easy in practice to predict the mobility pattern of normal nodes accurately.

IV. LOCALIZATION ESTIMATES

The localization performance from intermediate AOA estimates the Gaussian with variance as bound. This is then compared to variance σ^2_{rss} of the bound based on the entire set of raw RSS measurements.
Because the observations are assumed Gaussian in each case.

Case 1: RSS → (x, y)'s

In this case, the measurement vector s consists of all RSS measurements from all node pairs, $\{s_{irt}\}_{i\in V rt}, \forall r\neq t$ and has mean $E[s] = \mu_s$. The unknown parameters $\{x_n, y_n, \phi_n\}_n = 4{:}N$ and $\{\mu_{rt}\}_{r\neq t}$ are collected into a parameter vector p_1. Defining $G^T_{p18} \equiv \nabla p1\ (\mu^T_s)$, the FIM for estimating p1 from M independent observations of s is

$$\mathbf{I}_{p18} = M/\ \sigma^2_{rss}\mathbf{G}^T_{p18}\mathbf{G}_{p18},$$

and the associated bound on the covariance matrix for estimates p ̂1 is

$$\Sigma_{p18} \geq \sigma^2_{rss}/\ M\ [G^T_{p18}G_{p18}]\ -1\ ,$$

where for matrices, $A \geq B$ means that $A - B$ is positive semi-definite.

Case 2: RSS → θ ̂'s → (x, y)'s

In this case, the measurement vector θ ̂ consists of all $N^2 - N$ AOA estimates $\{\theta_{rt}\}_{r\neq t}$ and has an associated diagonal covariance matrix, Σ_θ,those elements are calculated.

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International Journal of Advanced Research in Science, Engineering and Technology
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For this case, the unknown parameter vector, p_2, only contains positions and orientations as $\{x_n, y_n, \varphi_n\}_n$=4:N . The FIM for estimating p_2 from $\hat{\theta}$ is

$$I_{p2\theta} = G^T_{p2\theta}\Sigma^{-1}_{\theta} G_{p2\theta},$$

The associated covariance of p_2 estimates obtained from $\hat{\theta}$'s is

$$\Sigma p_{2\theta} \geq [G^T_{p2\theta}\Sigma^{-1}_{\theta} G_{p2\theta}]^{-1} .$$

If $var(\theta') \approx$ constant for all arrival angles, then can be simplified by substituting $\Sigma_\theta = I\ var(\theta)$

$$\Sigma_{p2\theta} \geq \sigma^2_{rss} /M\ [\ G^T_{\Theta s}G_{\Theta s}\ ]^{-1}_{1,1}\ £[G^T_{p2\theta}G_{p2\theta}\ ]^{-1}$$

V. PROPOSED SYSTEM

In wireless sensor networks, the existing range-free localization techniques are based on either centralized approach or distributed approach. The centralized approach causes overhead, latency, and so forth, while the distributed approach is more complex. Different from the existing work on localization algorithms for mobile WSNs, we study the cooperation between neighbour nodes that achieve high localization performance. Our scheme belongs to the range-free category of localization algorithms in terms of target tracking under mobile wireless sensor networks. The centralized approach faces limitations related to overhead, latency, and so forth, whereas the distributed approach suffers from problems related to high complexity. Hence, we propose a hierarchical architecture, which uses the advantage of both centralized and distributed architecture. As a result, the hierarchical architecture overcomes the limitations of the existing works.

We introduce a range-free localization algorithm HitBall, for mobile sensor node networks. In order to address the sparse anchor node problem and high communication cost problem, our algorithm fully utilizes the advantages of the communication ranges (of nodes), historical beacons, and RSS (of beacons), which are free of communication cost. To the best of our knowledge, our algorithm is the first one to use the RSS of historical beacons in mobile sensor node localization. Our algorithm includes three new constrained regions. A constrained region is a region that can cover the location of the target normal node, e.g., the communication range of a one-hop neighbouring anchor node (which is widely adopted in existing range-free algorithms). According to the theoretical analysis and simulation results, the three constrained regions can indeed improve the localization accuracy. Besides, our algorithm has low communication cost (only one-hop beacon broadcasting is required). To achieve high location performance with low communication cost, propose a novel range-free localization prediction beacon localization protocol (RPBLP) based on duty cycle in target tracking application.

A. The Hitball Algorithm

Throughout this work, mobile sensor networks are assumed to have mobile normal nodes and mobile anchor nodes. Each anchor node is assumed to broadcast a beacon that carries its location information to its one-hop neighbouring normal nodes per slot (i.e., one-hop-beacon broadcasting). Each normal node can determine the possible region (of its location) by the aid of collected beacons. A possible region of normal node's location is a region which covers normal node's location. Clearly, a smaller possible region implies higher localization accuracy. A beacon is called a **current beacon** if it is delivered in the current time slot, and a **historical beacon** otherwise (i.e., prior to the current time slot). Associated with each current beacon, there is a one-hop anchor- constrained region, which is the communication range of the anchor node when it sent out the beacon.

Besides, associated with each historical beacon, there is a historical-anchor-constrained region, which is a circle centred at the anchor node that sent out the beacon. If the historical beacon was delivered t time slots ago, then the circle has a radius of r+vmax_t, where r is the communication radius of an anchor node and vmax is the maximum moving distance of a normal node during a time slot.

The Hit Ball algorithm and MCL-based range-free localization algorithms determine the possible region of normal node's location by finding the intersection of all one-hop-anchor-constrained regions of normal node with others constrained regions (e.g., historical anchor- constrained regions and ring areas centred at two-hop neighbouring anchor nodes of normal node). In these algorithms, more constrained regions can determine a smaller possible region of normal node's location and hence improve the localization accuracy. Our possible region of normal node's location is the intersection of one-hop-anchor-constrained regions, historical anchor- constrained regions, and the proposed three

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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RSS constrained regions. Use RSS values of beacons to derive three constrained regions, **CC-region, CH-region and HH-region.** Developing the three constrained regions requires extremely low communication cost (only one-hop-beacon broadcasting).

B. Range-freelocalization predictionbeacon localization protocol (RPBLP)

In order to overcome these issues, in this work, we propose a dynamic anchor nodes selection with duty cycle based architecture for range-free localization in sensor network. Initially anchor nodes are selected based on the receiving target beacon. Under prediction of target beacon, set of neighbour's start scanning process which helps in estimating the position of target sensor nodes with reference to the anchor sensor nodes location. Under this work selection and usage of the anchor nodes within each neighbour set reduces the overhead and complexity in the network. At every sampling instant, only one neighbour set of sensors that located in the proximity of the target is activated which act as actor nodes, whereas the other normal nodes are inactive. This duty cycle scheme is to solve the problem of the unbalanced energy consumption and harvesting speed in ambient powered mobile WSNs, which applies a transmission power control scheme to enhance or minimize the communication distance of nodes based on the energy level situation. By applying such a scheme, the nodes with superior remaining energy resource or higher energy harvesting capability will take more responses to the network packet delivery, while the other sensor nodes will be in an sleep state for longer time.

C. Duty Cycle Based Scheduling:

Due to economic considerations, mobile sensor networks characteristically have sparse anchor sensor nodes which make most range-free localization algorithms inaccurate. However, due to the power restriction of mobile sensor nodes (i.e., they are battery-operated) and high energy consumption by communication, huge communication cost will significantly reduce the network life time. Measurements have revealed that the power that a node spends even as idly listening amounts to 50%-100% of the energy required for receiving. Furthermore, typically, a normal node would spend a substantial fraction of the time in the idle state. So, idle listening state has been known as one of major sources of energy waste in sensor networks and duty cycle based scheduling has been widely important. The mainstream of research on duty cycle based scheduling can be divided into two approaches. One approach, the "periodical packet-beacon", consider periodical packet arrival, thus proposing a periodic active/sleep schedule.

The 2nd approach is "coverage-beacon", which assumes high density of nodes, thus maintaining the connectivity of the wireless network by a subset of nodes which are ON all the time, at the same time as letting the other sensor nodes in sleep state. There also different strategies for adaptation of the sleeping schedule, the ON state time period according to dissimilar criteria, such as the overheard messages, the network topology, the residual energy/power of the sensor nodes, the mainly updated neighbour sleeping schedule, the table of neighbour nodes' sleeping state schedule, the most number of packets queued in the MAC layer, and the waiting time of packets and the length of waiting queue in the previous node.

VI. IMPLEMENTATION OF RPBLP

Our scheme belongs to the range-free category of localization algorithms in terms of target tracking under mobile wireless sensor networks. In order to address the sparse anchor node problem, energy consumption and high communication cost problem, our RPBLP fully utilizes the advantages of the communication ranges (of nodes), prediction beacons, and RSS (of beacons), which are free of communication cost.

We utilize two approaches to reduce the energy consumption during this proactive wake-up process:

1. Reduce the number of listening sensor nodes.
2. Formulate the sleep prototype to shorten the active time.

In this module, this quantifies the benefits of our protocol in terms of energy/power consumed and tracking accuracy under different mobility patterns. The key problem in tracking a mobile node as target is accuracy of tracking and energy expenditure. The accuracy of tracking is powerfully influenced by the number of active nodes (active under target prediction beacon). The more sensor nodes that are in active state, among the nodes the higher node will be able

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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to track accurately. Too few will result in inaccurate tracking. Therefore, energy/power expenses is proportional to the amount of active sensor nodes; the larger the size of the active tracking area, thus higher energy consumption. To accurately track the target and minimize energy, a low set of sensors nodes need to be active under prediction beacon.

VII. INPUT CONFIGURATION SETUP

This module require to configure some parameters which is supported to execute our proposed routing protocol like Nodes count, Mobility type, Layer -MAC protocol, Simulation time, Band width, Coverage range etc… by setting these kinds of parameters execute our proposed routing protocol with others layers interaction. Setup the layer wise result outcomes in the configuration procedure.

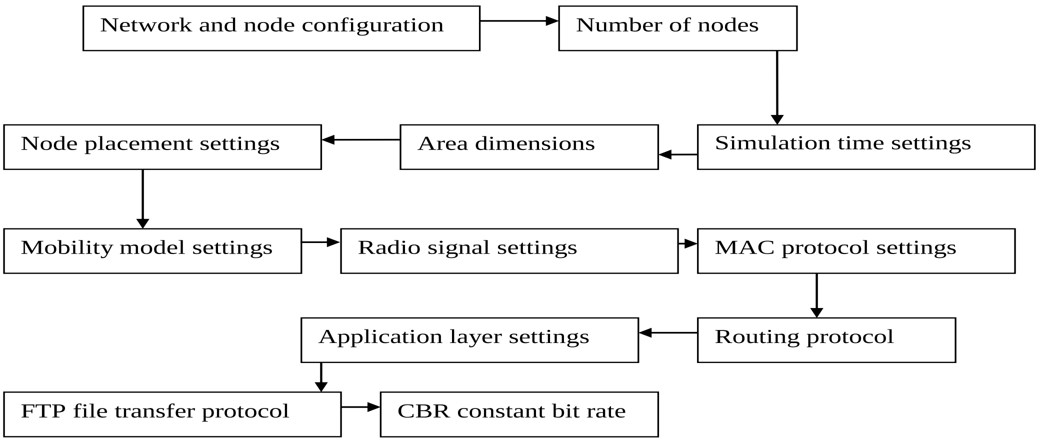

Fig.8.1 Input configuration of RPBLP

A. Performance Measurements

First, we need to specify the essential input parameters in the Config input file as said above. For our simulation procedure, we have been specific about certain feature parameters as mentioned below to enable hassle free simulation

Terrain range – (1000,1000)

Number of nodes – 50 (This is a scalable simulator. Hence number of nodes can be increased at will.)

These parameters were holed for the whole process of experimentation with the new protocol.

The performance of the proposed algorithm is evaluated through glomosim simulator. Performance metrics values are utilized in the simulations for performance comparison:

Packet arrival rate. The percentage of the number of expected data packets to the number of total packets sent by the source node.

Average end-to-end delay. The average time elapsed for delivering a data packet within a successful transmission in a network.

Communication overhead. The average number of transmitted control bytes per second, including both the data packet and the control packets.

Energy consumption. The energy consumption for the entire network, including transmission energy consumption ate for both the data and control packets.

ISSN: 2350-0328

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VIII. RESULT AND DISCUSSION

We conduct test evaluation on our prototype. Our evaluation process focuses on comparing the energy efficiency and beacon localization process of the proposed system. The Duty Cycle based schedule save the energy efficiency and target received successfully using beacon localization process in a network setup.

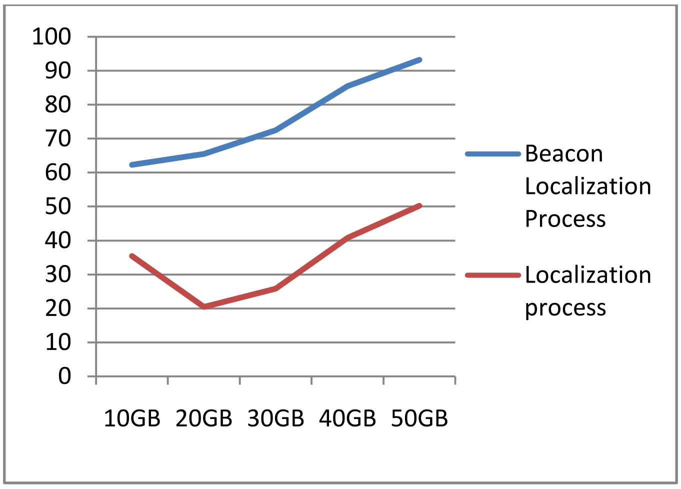

Fig 8.1 Comparison OfBeacon Localization Process With Localization Process

In the above fig 8.1 comparing the localization process with beacon localization process. Thus, the target identified accurately by using beacon localization process then other localization process.

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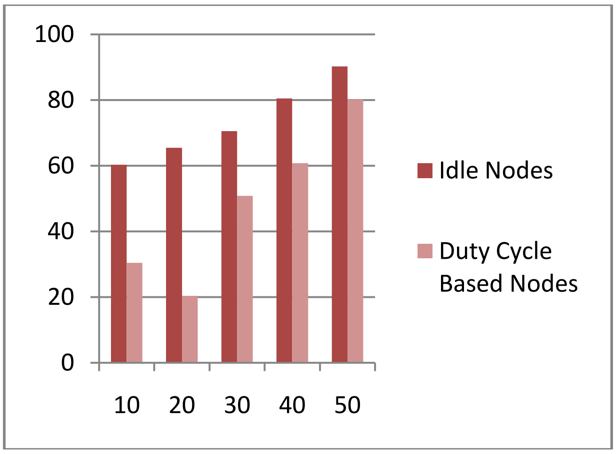

Fig.8.2 Comparison OfIdle And Duty Cycle Based Nodes

Similarly the energy efficiency of idle nodes in existing system is compared with duty cycle based nodes. In this fig 8.2 energy wastage is overcome by using duty cycle based nodes.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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IX. CONCLUSION

In WSN with latest advances in technology, it has become possible to consider the deployment of large-scale wireless sensor networks that can offer premium environmental monitoring for a range of applications.Range-free localization procedures for mobile networks usually experience from sparse anchor node problem and high communication cost. To overcome the problems mentioned above, in this paper, we use RSS values of beacons to derive three constrained regions, CC-region, CH-region and HH-region. Developing the three constrained regions requires extremely low communication cost (only one-hop-beacon broadcasting). According to the theoretical analysis and simulation results, the proposed three constrained regions do indeed improve the localization accuracy.

X.FUTURE SCOPE

Our future work will be focused on overcoming the current limitations of the hitball algorithm. The VFA algorithm can be made more efficient if it is provided with the theoretical limits on the number of sensor nodes required to achieve a given coverage threshold. Also, there is no route plan for relocation the sensor nodes in the VFA algorithm, where sensor collision can happen during the repositioning. Much of the work presented here can also be extended to dynamic target tracking to deal with environmental phenomena that change location or shape over time.

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