ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

*International Journal of Advanced Research in Computer and Communication Engineering*
*Vol.2, Issue 12, December 2013*

# Comparison of Path Planning Algorithm for WSN: LMCS, Robust Interval-Based Localization Algorithms, Localization Based on Genetic Algorithm

**T.S.Lokhande[1], Prof. R. R. Shelke[2]**

Department of Comp. Sci. &Engg.

H.V.P.M's college of Engg. & Tech.

Amravati University, India

**Abstract:** Node localization technology is especially important to most applications of wireless sensor network. There are different path planning algorithms for wireless sensor network. However, each mobile beacon needs to broadcast its current position many times, and locating all the nodes must take a long time in most of the localization algorithms. In order to solve these problems, we propose a novel range-free localization algorithm—localization with a mobile beacon based on compressive sensing (LMCS). Robust interval based localization algorithm, this algorithm perform set-membership estimation, where only the maximal number of outliers is required to be known. Using these algorithms, estimates consist of sets of boxes whose union surely contains the correct location of the sensor, provided that the considered hypotheses are satisfied. This technique evaluates the number of outliers to be robust. Localization in wireless sensor network based on genetic algorithm, approximate the distance between anchor node and unknown node which is out of the anchor node's communication radius.

**Keywords:** Wireless Sensor Networks(WSNs), Genetic Algorithm(GA), Localization, Mobile Beacon, path planning Algorithm

## I. INTRODUCTION

Wireless sensor networks (WSNs) are based on the technology of sensor, wireless communication, tiny embedded devices, and distributed computing. They exchange information with the environment through sensors and implement the function of collecting and dealing with data. Wireless sensor networks have been widely used in the fields of environmental monitoring, target tracking, military applications, disaster management, routing, monitoring. A wireless sensor network is composed of a large number of cheap and energy limited sensor nodes, which are densely distributed in a field, and each sensor node can detect specific events in its sensing field. In wireless sensor networks, there are several important issues (e.g., localization, deployment, and coverage). However, localization is the most essential problem because the location information is the important premise for deployment, coverage, routing, monitoring, and tracking. There are different algorithms used for localization.

Many localization algorithms, broadly divided into two categories, have been proposed, including range-based schemes and range-free schemes. The range-based schemes are achieved by measuring the distance between two neighbor nodes. For instance, the distance can be calculated based on the Received Signal Strength Indication (RSSI), Time of Arrival (TOA), Time Difference of Arrival (TDOA), or Angle of Arrival (AOA). The range-based location algorithms have high location precision common, but it require additional measuring equipment. Many range-free schemes have been proposed.

## II. RELATED WORK

*Localization Difficulty*

A WSN consists of a large number of low-cost smart sensors with limited computational capacities and energy resources. Due to the lack of a fixed infrastructure in MSNs, the sensors are able to move in an uncontrolled manner. For this reason and since sensed data are related to the locations of the sensors in almost all WSN applications, many researchers have focused on the localization problem. A first solution for sensor localization is to equip all sensors with Global Positioning Systems (GPS). However, this solution is non-practical in WSNs, since GPS are expensive, high energy consuming and having great sizes. The alternative solution consists of equipping a few numbers of sensors with GPS receivers. These sensors, aware of their locations, are called anchors. The remaining sensors, called non-anchor nodes or simply nodes, have unknown locations, and hence they need to be localized.

Many anchor-based algorithms have been proposed for sensor localization. For instance, Doherty et al. propose a centralized technique for position estimation. Localization in is formalized as a convex optimization problem, having connectivity measurements between sensors as constraints. Local maps with relative positions are constructed using measured distances between nodes and their neighbors. A combination of these maps with known positions of anchors leads to absolute positions. Nevertheless, these techniques are not very robust, because of errors accumulation while combining the maps.

More recently, there are many researchers put graph rigidity theory into localization of WSNs, they have made a lot of contribution on it. The methods proposed by S. Lederer et al. just use the network connectivity information to get the position of unknown nodes. In order to obtain the nodes' position, they partition the network into voronoi cells with using Delaunay triangles closest to the shape of region of concern. These kinds of methods are good choice of localization plan for underwater, underground or indoor environment, but in these way we can't localization in the environment with obstruction or unconnected well. Apart from this, the locations of landmarks should know before localization. How to obtain the nodes' position in obstruction or unconnected well environment also is the research hotspot for us.

Many algorithms have been proposed to solve the localization problem in the literature. Excellent surveys of the related studies can be found in . The major localization studies

are summarized in the section below:

*Range-Based:*

The range-based schemes are achieved by measuring either node-to-node distances or angles to estimate locations. The typical range-based schemes include strategies based on RSSI, TOA, TDOA, and AOA. In the RSSI is converted to distance information and then node's location is estimated by using the triangulation. Bergamo and Mazzini propose a triangulation strategy for the localization and analyze the effects of fading and sensor mobility on localization. To estimate its possible locations, node uses the beacon advertisements received for ranging. Niculescu and Nath compute comparative angles between neighboring nodes for angulations.

*Range-Free:*

Due to the sensor devices' hardware limitations, the range-free schemes are more economic than the range-based schemes. Centroid scheme is proposed by Bulusu et al. Centroid formula based on received beacons' locations is used to determine node's locations. Niculescu and Nath introduce DV-Hop approach to estimate node's locations by measuring hop-counts from each node to specific beacons. The DV-Hop algorithm is improved by using RSSI technology. APIT scheme uses few beacons to locate each sensor node, but needs high density of beacons. Tran and Nguyen propose LSVM algorithm, which applies SVM to locate sensor node.

*Mobile Beacon:*

As beacons are powerful but expensive, it is very important to minimize the number of beacons, which is used to locate nodes' position. Assume few beacons can move and periodically broadcast their locations, in other words, many statistical beacons can be replaced by few mobile

beacons. Therefore, many schemes are proposed by using a beacon or few beacons. Widely speaking, these schemes can also be divided into range-based and range-free. A range-based localization mechanism combined with the RSSI technique, sensor nodes' possible locations can be estimated by hearing a single mobile beacon. Sun and Guo's probabilistic localization algorithm based on a mobile beacon utilizes TOA technique for ranging and uses Centroid formula based on distance information to estimate nodes' location. Xia and Chen present a localization scheme by using TDOA technique with mobile beacons, in which the nodes use trilateration to decide their locations.

In this paper we compare different localization approach. First LMCS then Robust interval-based localization algorithms and third is Localization Based on Genetic Algorithm

## II. LOCALIZATION WITH A MOBILE BEACON BASED ON COMPRESSIVE SENSING (LMCS)

LMCS makes use of compressive sensing (CS) to get the related degree of the sensor nodes and all the mobile beacon points. According to the related degree, the algorithm decides the weight value of each beacon point for the mass coordinate, and estimates the sensor node location. LMCS does not ask for all nodes hearing directly with beacon node, so it is more suitable for practical application than other localization algorithms. The simulation results show that compared with MAP schemes, LMCS has better localization performance, especially under irregularity of radio range and obstacle environment. Therefore, LMCS is a reliable, useful, and effective localization algorithm.

*Algorithm*: The algorithm for the sensor node localization mainly includes three parts. First, calculate the correlation coefficient between the sensor node and all beacon points. Second, utilize the correlation coefficient ensured above to compute the weighted value between the sensor node and all beacon points. Finally, estimate the location of the sensor node. The process of LMCS is described as follows.

ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol.2, Issue 12, December 2013

Algorithm(estimate the location of the sensor node $Sj$) is as follows.

(1) Input: the measurement $Yj$, the sampling dictionary $A$, and all beacon points' positions (($Bi$), ($Bi$)) ($i$ =1, 2, . . . , $k$).
(2) Output: the position (($Sj$), ($Sj$)) of the node $Sj$.
(3) The process for the sensor node localization is as follows
(a) Calculate the correlation coefficients between sensor node $Sj$ and all beacon points by CS;
(b) Use the correlation coefficients obtained above to compute the weighted values both them by
(c) Estimate the position (($Sj$), ($Sj$)) of the sensor node $Sj$.
According to the principle description, the key to locate a sensor node is the related degree between the sensor node and all beacon points. Then the localization Protocol of sensor nodes can be divided into three stages.

## IV. ROBUST INTERVAL-BASED LOCALIZATION ALGORITHMS

This technique considers the localization problem in mobile sensor networks. Such a problem is a challenging task, especially when measurements exchanged between sensors may contain outliers, i.e., data not matching the observation model. There are two algorithms robust to outliers. These algorithms perform set-membership estimation, where only the maximal number of outliers is required to be known. Using these algorithms, estimates consist of sets of boxes whose union surely contains the correct location of the sensor, provided that the considered hypotheses are satisfied. This technique evaluates the number of outliers to be robust.
*Algorithm*: In this technique an original adaptive approach for sensor localization in presence of outliers. Interval analysis is employed to achieve this goal. At each time step, the proposed method computes a set of non-overlapping boxes, called subpaving, whose union covers the solution set X(t). Assume that [X](t) is the solution subpaving containing the actual position of the generic node at time t. One has

$$[\mathbb{X}](t) = \bigcup_{1 \leq j \leq n(t)} [x_j](t),$$

## V. LOCALIZATION OF WIRELESS SENSOR NETWORK BASED ON GENETIC ALGORITHM

This technique is a new way to approximate the distance between anchor node and unknown node which is out of the anchor nodes communication radius. In addition to this technique self-adapting genetic algorithm used for localization, which will ensure that the result produce is as similar as its real position in any environment. The experiments on various network topologies show the better results.

Pseudo code of localization based on genetic algorithm

```
Step 1: Initialization
The number of individuals, NIND;
The maximum number of generation, MAXGEN;
The precision of variables, PRECI;
The generation gap, GGAP;
Initialized the times of generation gen= 0;
The number of anchor nodes, NodeNum;
The number of aimnodes, AimNum;
The distance between anchor and aimnode, D;

Step 2: Coding
Generate the position of aimpiont by Gray code randomly, AimP(t);

Step 3: Evaluate
for n = 1; n < AimNum; n++
t = 0;
for j = 1; j < NIND; j++
F(j) = 0;%F(j) is the fitness function to the group
for i = 1; i < NodeNum; i++
F(j) = dist( NodeP(i) − AimP(j) ) − D(n,i) + F(j);
end
end
end

Step 4: Select, Crossover, Mutation, Reproduce
while t < MAXGEN
Evaluating the fitness of the new group;
Selecting the individuals for Crossover;
Crossing the selected individuals by certain probability;
Mutating the individuals of group by certain probability;
Evaluating the fitness of the new group;
Producing a new group after the evolution, AimP(t);
Partial Best = min(F(j));
Update the times of generation, t = t + 1;
end

Step 5: Obtain the result
AimP = Decode(Partial Best);
```

## VI. COMPARISION OF THREE ALGORITM

Localization with a mobile beacon based on compressive sensing, LMCS, uses the connectivity information to locate the positions of all sensor nodes. First, the mobile beacon periodically sends a message, and each sensor node gets the hop-count from the position, where the mobile beacon broadcasts the message. The mobile beacon obtains the connectivity information between all beacon points through the use of sensor nodes. Then, we utilize all connectivity information to compute the degree of correlation between the sensor node and all beacon points by CS. Finally, by the

ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

*International Journal of Advanced Research in Computer and Communication Engineering*
*Vol.2, Issue 12, December 2013*

degree of correlation, we can get the locations of all sensor nodes. LMCS also has few shortcomings, such that it needs sensor node to obtain the connectivity information, and it consumes energy of sensor node.

Assuming only that the maximal number of outliers is given, the proposed approach uses connectivity measurements in addition to a mobility model to address the localization problem. The solution is then given using either SIVIA or an alternative combinatorial technique. This technique evaluates the maximal number of outliers to be robust. Moreover, using a connectivity-based observation model, the technique compares the performances of both robust localization algorithms.

Genetic Algorithm (GA) is a bionics optimize algorithm. It has been put forward by John Holland on 1975. It is based on Darwin's biological evolutionism which is "survival of the fittest" and Mendel's genetic variation principle which is "biological genetic evolution mainly take place in the chromosome".

This technique uses Genetic Algorithm (GA) into localization of WSNs, the approach causes nodes in the environment with obstruction or unconnected well could get high accuracy position by themselves.

## VII. CONCLUSION

In this method we study three path planning algorithm. First is localization with a mobile beacon based on compressive sensing (LMCS), LMCS adopts the connectivity information to localize each node also it is more suitable for practical application. LMCS can completely locate all nodes with few beacon points. Second, Robust interval based localization algorithm, Using interval analysis, the estimates are sets of non-overlapping boxes containing the actual location. The SIVIA-based algorithm (SBL) bisects the search region leading to many boxes describing efficiently the solution set; the combinatorial method (CBL) leads to larger boxes including the solution as well. In order to reduce error during localization, we use new means to approximate the distance between unknown nodes and anchor nodes when it is larger than node's communication radius. Moreover, we use self-adapting genetic algorithm to calculate the similar position of nodes, it makes the localization error much lower than the common method.

## REFERENCES

[1] J. Albowicz, A. Chen, and L. Zhang, "Recursive position estimation in sensor networks," in *Proceedings of the 9th International Conference on Network Protocols*, pp. 35–41, 2001.

[2] H. A. Oliveira, E. F.Nakamura, A. A. F. Loureiro, and A. Boukerche, "Directed position estimation: a recursive localization approach for wireless sensor networks," in *Proceedings of the 14th IEEE International Conference on Computer Communications and Networks*, pp. 557–562, San Diego, Calif, USA, 2005.

[3] P. Bahl and V. N. Padmanabhan, "RADAR: an in-building RFbased user location and tracking system," in *Proceedings of the 19th Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM'00)*, pp. 775–784,March 2000.

[4] P. Bergamo and G. Mazzini, "Localization in sensor networks with fading and mobility," in *Proceedings of the 13th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC '02)*, pp. 750–754, Ferrara, Italy, September 2002.

[5] N. Bulusu, J. Heidemann, and D. Estrin, "GPS-less low-cost outdoor localization for very small devices," *IEEE Personal Communications*, vol. 7, no. 5, pp. 28–34, 2000.

[6] J. Wang, P. Urriza, Y. Han, and D. Cabric, "Weighted centroid localization algorithm: theoretical analysis and distributed implementation," *IEEE Transactions on Wireless Communications*, vol. 10, no. 10, pp. 3403–3413, 2011.

[7] L. Doherty, K. Pister, and L. El Ghaoui, "Convex position estimation in wireless sensor networks," in *Proc. INFOCOM'01*, vol. 3, 2001, pp. 1655 –1663. [Online]. Available: http://www.citeulike.org/group/7128/article/3014236

[8] S. Capkun, M. Hamdi, and J.-P. Hubaux, "GPS-free positioning in mobile ad-hoc networks," in *Hawaii Int. Conf. on System Sciences (HICSS-34)*, Maui, Hawaii, January 2001, pp. 3481 –3490. [Online]. Available: http://pi4.informatik.unimannheim.de/∼haensel/sensornetze/Capkun.pdf

[9] S. Lederer; Y. Wang; J. Gao(2008); Connectivity-based localization of large scale sensor networks with complex shape, *In Proceedings of the 27th Annual IEEE Conference on Computer Communications*, ISSN 0743-166X, 789-797.

[10] L. Cheng, C. Wu, Y. Zhang, H. Wu, M. Li, and C. Maple, "A survey of localization in wireless sensor network," *International Journal of Distributed Sensor Networks*, vol. 2012, Article ID 962523, 12 pages, 2012.