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Significance of Meta Heuristic Algorithms for Localization in Wireless Sensor Networks

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Abstract: ***In many situations, it is important or necessary for nodes in wireless sensor network to be aware of its location in the physical world to tracking or event detection function. There is a missing of getting 100% accuracy about node's localization due to absence or limitations of anchor nodes capabilities. In literature there are many number of algorithms existed such as, Practical swam optimization, ant colony optimization, BAT, bacterial foraging driven at algorithm (BDBA) and firefly driven bat algorithm (FDBA) etc, was proposed. To provide good localization some reference methods needs to follow. In this paper a comprehensive survey over many localization algorithms and a comparison on existing algorithms provided with one proposed technique for nodes localization. It shows importance of meta heuristic methods for localization of nodes in WSNS.***
Keywords: Wireless sensor network, localization, algorithms, optimization, GPS, BAT algorithm, meta heuristic.

I. INTRODUCTION

WSNS (WSNs) consists of number of sensor nodes randomly distributed in the field. Generally these sensor nodes having sensing element, communication system, limited processing system, less memory and less power. These networks are having so many constraints such as, lack of proper communication, routing issues, limited energy due to this they are not sustained for long time. Although they are having such limitations, it provides many number of services in different fields like military, navigation, health sector and agriculture etc,.

Sensor nodes provide data of particular event happened. Tracking of objects is one of the main application of WSNs is called Localization. It means finding the sensor node's position using Global positioning system(GPS).In sensor networks some sensor nodes are equipped with GPS system with that localization can be possible[1]. But the drawback of this system is, it does not work in indoor environment.

In sensor networks nodes are required with routing information to send the sensed data to the destination or base station[8]. The sensor node's location can be identified by localization concept for that various algorithms can be used, in this maximum algorithms are nature inspired algorithms[7]. The authors in [5] proposed BAT algorithm which is nature inspired algorithm. GPS equipped sensor nodes can be used for localization but this system does not work in all types of environment. In [4], the author proposed BAT algorithm which can be performed in number of ways.

In literature number of optimization algorithms were existed for localization these are practical swam optimization(PSO), bat algorithm, firefly algorithms and bacteria foraging algorithm etc,. There are some more possible approaches to determine the node's position in a network. Among such as by using information about a node's neighborhood, exploiting the geometric parameters of a given scenario and comparison method[14].

The communication between two nodes is a geometric relationship i.e. lateral distance or angular distance with this information some algorithms are existed in literature. The sensing data can be sent to the base station whether through single hop or multi hop communication method.

Based on these two techniques localization methods are placed in literature. For finding the position of a sensor node Distance vector hop algorithms was existed in literature which provides better localization among different methods. These many algorithms were existed in literature for node's localization but still it is a challenging task for many researchers due noise in the environment and placement of anchor nodes in the field. In this paper a comprehensive comparison is performed based on recently invented algorithms for showing the importance of meta heuristic techniques for localization in WSNs. The rest of the paper is organized as follows: In Section 2, the network structure for localization is presented. In Section 3,Various techniques for localization in WSNs. In Section 4, proposed method and in Section 5,simulation comparison over previously discussed algorithms. Last Section 6, conclude the paper.

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II. THE NETWORK STRUCTURE FOR LOCALIZATION

WSNs having no predefined structure and nodes are placed in ununiform manner. After deployment of sensor nodes in the field, the sensors sense the physical information about environment like temperature, pressure, fire and moisture etc, and sent the physical information the base station(BS) by using communication among all the nodes. But in case of localization this scenario is different from normal sensing field the way use of nodes in the field. Here we require a special category nodes are employed for finding the unknown nodes position. These nodes are employed with Global position system(GPS) technology called anchor nodes or localization nodes. Anchor nodes are the nodes used for identifying unknown or target nodes in the network. In this section, we are describing a sample scenario for localization by using these anchor nodes. In Fig 1, it explains the placement of sensor nodes and anchor nodes in the network. By using these anchor nodes , the unknown sensor or target nodes position can be identified with help of some geometric algorithms. In Fig 1, three categories of nodes are existed. The target nodes are find out by using anchor nodes because these anchor nodes are having GPS technology, they know their position[10]. Placing more number of anchor nodes in the network , we will get more accuracy of localization. The disadvantage from this GPS technology is cost factor which is high if nodes are increasing. In addition to this system does not work in indoor environment. To avoid such type of problems nature inspired genetic algorithms are preferred.

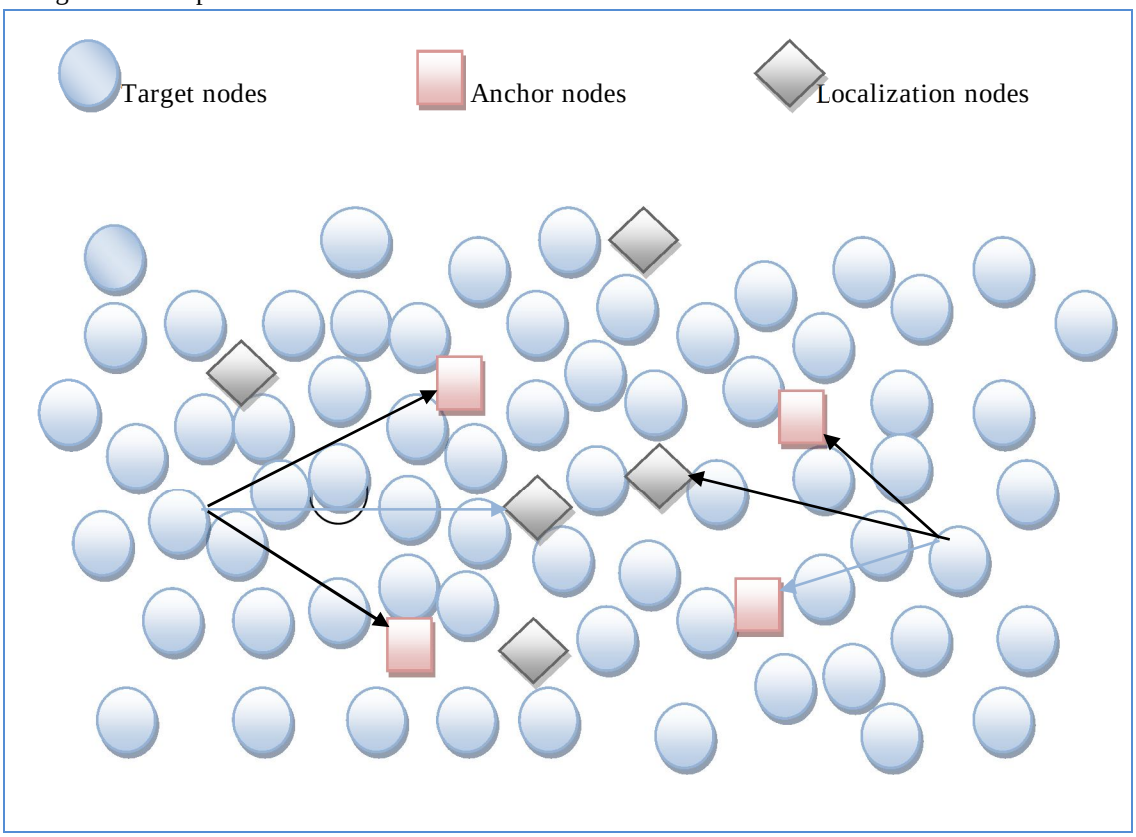

Fig 1: A simple Localization of WSN scenario

III. VARIOUS EXISTING METHODS IN LITERATURE

The localization algorithms were divided into various types based on measurement techniques. These algorithms are different for different applications. For designing localization algorithms various factors can be taken into account such as network structure , sensing nodes concentration, number of GPS equipped nodes, geometric shape of the measurement area and sensor time synchronization etc,. These techniques are discussed as follows[15]

A. Angle of Arrival (AOA) Measurements

These are well suited for localization of sensor nodes. In these methods for calculating position of sensor node minimum two anchor nodes are required. The localization mean error is large if there is a small error in measurement [15]. Here accuracy depends on directionality of antennas.

B. Distance related Measurements

These measurements are further classified into time of difference of arrival (TDOA), RSS based and connectivity based measurements[15].

1) Time difference of arrival measurements measures the difference between the arrival times of a transmitting signal at two separate receivers. The distance between receivers are increased accuracy is improved [15].

2) Received Signal Strength based measurements are done based on the estimate of length between the nodes from received signal strength of the signal [18,23].

3) Connectivity based measurements are easiest techniques. A sensor node is communicated to other node when both are in same transmission radius range. Based on the hop count distance these algorithms are estimating position of unknown sensor node.

C. Range free Localization Algorithm

This technique is working on data of the received packet and it is much better solution than many range free algorithm [16]. Here localization of a node can be find out by using geometric interpretation, constraint minimization and resident area formation [17].

D. Hop Count Based Method

In this type of approach DV-HOP and centroid methods are very much useful for node's localization [15]. Centroid method requires three anchor nodes, with that node position can be estimated. This method is very low computation and communication cost. It is a good algorithm when placement of anchor nodes is regular.

DV-HOP is the best algorithm wrt give the distance estimation from sensor nodes to the anchor nodes. Depends on the available of hops in WSN, the distance estimation is propagated by anchor nodes through that average distance is calculated to each node and localization can be performed.

E. Mobile Anchor Based Algorithm

Here a mobile anchor with GPS is moved entire the network and broadcast geometric coordinate among all the remaining nodes. It is one of the best method in localization with this we can reduce the energy also [15].

F. BAT Algorithm

This method is one of the best mechanism to find out unknown nodes distance. Because it offers some feature like frequency tuning, automatic zooming and parameter control. For any meta heuristic algorithm these parameters are important to get better optimization. This algorithm works on the echolocation process by emitting sounds towards objective and get sounds re bounce back to the emitter[21].

The pulse frequency found by using below equation

$f_i = f_{min} + (f_{max} - f_{min}) \beta$ ----------→ A

It is a standard bat algorithm equation. The velocity function shown below

$V_i^t = V_i^{t-1} + (x_i^t - x^*) f_i$ ----------→ B

Where x^* is a existing global best location which is positioned after comparing all the solutions among all n bats at each iteration is given as

$x_i^t = x_i^{t-1} + v_i^t$ ----------→ C

Where v_i^t is the velocity at time step t. By adding velocity function a new solution can be find. In this way bat algorithm is working.

G. Bacteria Foraging Driven Bat Algorithm (BDBA)

This algorithm find out a new solution by multiplying velocity function with some random number to provide changes in the previous velocity results. Every time solution gets updated until best solution occurred[13].

$$x_i^t = x_i^{t-1} + v_i^t * \frac{\Delta i}{\sqrt{\Delta_i^T * \Delta_i}} \quad \text{----------→ D}$$

Where Δ_i represents random number generated between [-1,1]. This algorithm gives better results than Bat algorithm.

So, likewise there are number of localization algorithms are existed in literature. But compared to all some meta heuristic methods minimize the system overhead and works efficiently.

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IV. PROPOSED METHOD

Bat algorithm offers better localization of wireless sensor nodes. Some meta heuristic algorithms are developed based on combining of bat algorithm with some other genetic algorithm. These techniques proved with better results in such scenario the FDBA algorithm is one of that method. It improved better in minimization of mean error. The principle behind this is the velocity function gets updated by some constant parameter every time with random number generation between [0,1] shown below [15]

$v_i^t = v_i^{t-1} + (x_i^t - x^*)\, f_i + C^* \exp(-\beta^* \beta)$ ----------→ E

Where C is constant and β is random generation of [0,1] from [15].

The proposed method offers better results from FDBA algorithm is by doing some accurate distance measurements after finding some solutions from each iteration. By maintaining parameter tuning at the emitter and evaluate the corrective accurate distance measurements from all searched solution and come to select as a better solutions for that iteration. For this we need to maintain nodes with better GPS technology node as anchor nodes in the network. By careful observation distance from anchor nodes to unknown nodes the localization error can be reduced further. This proposed algorithm shows a little bit improvements of mean error when compared with the existing FDBA and other such algorithms. The propose algorithm shown below figure.

The procedure for finding node position, error and mean localization error from reference paper [15]

Normally distance always includes with some noise. In this case node position can be calculated by using distance from anchor node to unknown node is

$G_i = G_i + n_i$ ----------→ F

Where n_i is noise and G_i is the estimated distance. The distance between unknown node and the anchor node is calculated as

$G_i = \sqrt{(a-b_j)^2 + (c-e_j)^2}$ ----------→ G

The mean localization error can be calculated as

$$\text{MLE} = \frac{\sum_{i=1}^{N} G_{i-G_j^*}}{N(R)} \quad \text{----------→ H}$$

Where R is the transmission range and N is number of sensor nodes. The proposed algorithm procedure shown below

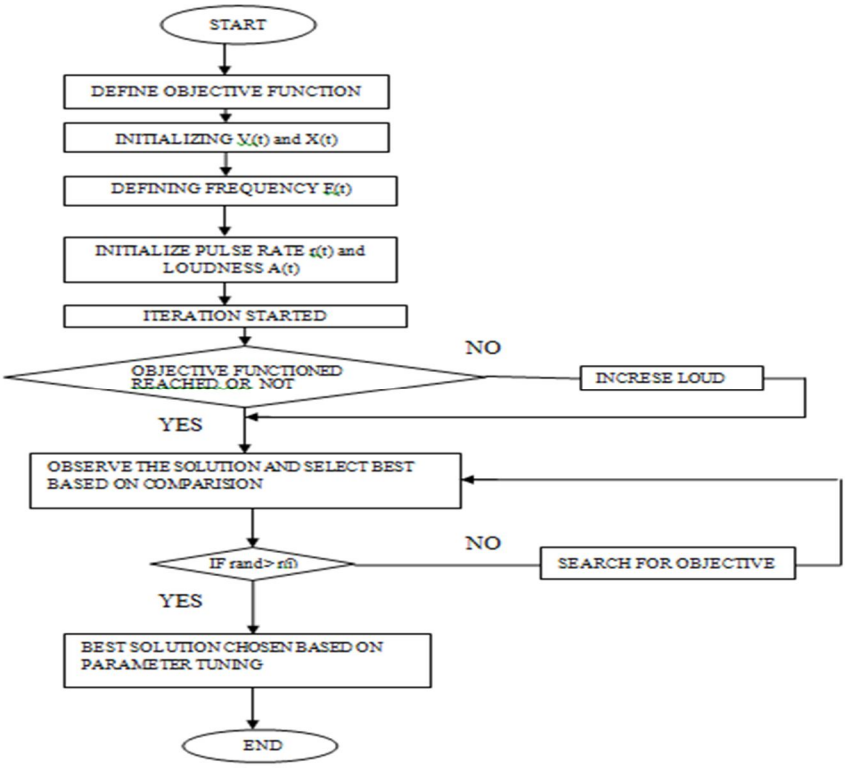


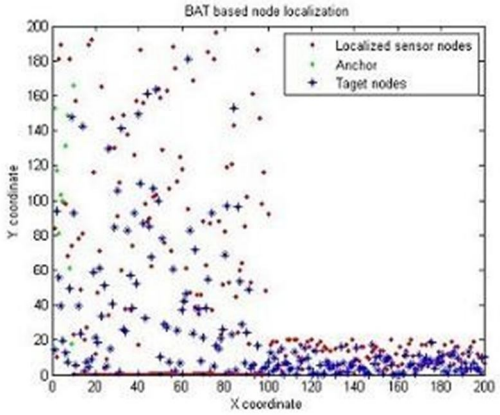
Fig 2 : Flow chart of IDFDBA algorithm

V. SIMULATION ANALYSIS

For the simulation of proposed algorithm we have to make some frequency tuning and accurate distance measurement mechanism has to done in simulation setting with time parameter. The proposed IDFDBA algorithm offered some little improvement over mean localization as compared with other meta heuristic algorithm like FDBA. The below table shows simulation parameters.

Table 1: Network simulation parameters

Required Parameters	Value
Area	200*200
Communication range of nodes	35 m
No of target nodes in network	200
Initial frequency to operate network	0.2
Highest frequency in the network	180
No of GPS nodes required	10 nodes to 100 nodes
No of iterations minimum	100



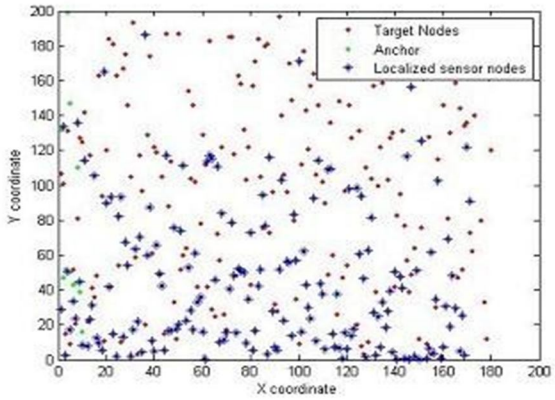


Fig 3: Network scenario in BAT method Fig 4: Network scenario in IDFDBA method

The above figures show nodes localization in BAT and improved IDFDBA scenario. Node localization performance can be further improved with this algorithm.

The below fig 5 represents the error performance for various types of algorithms. It shows our IDFDBA offers some more improved error results by maintaining good accuracy and proper distance measurements from anchor nodes to target nodes.

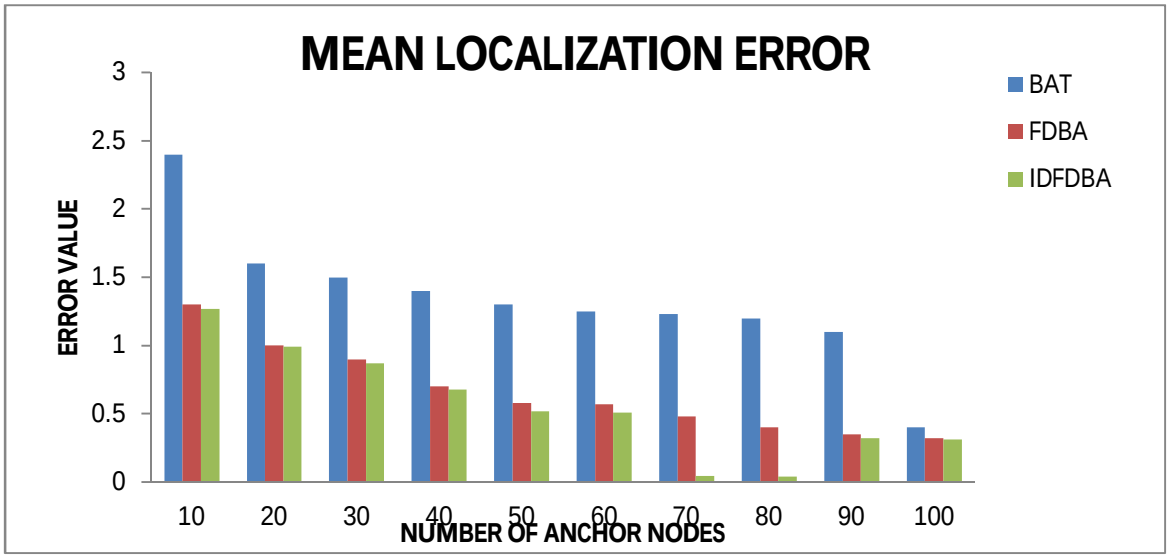


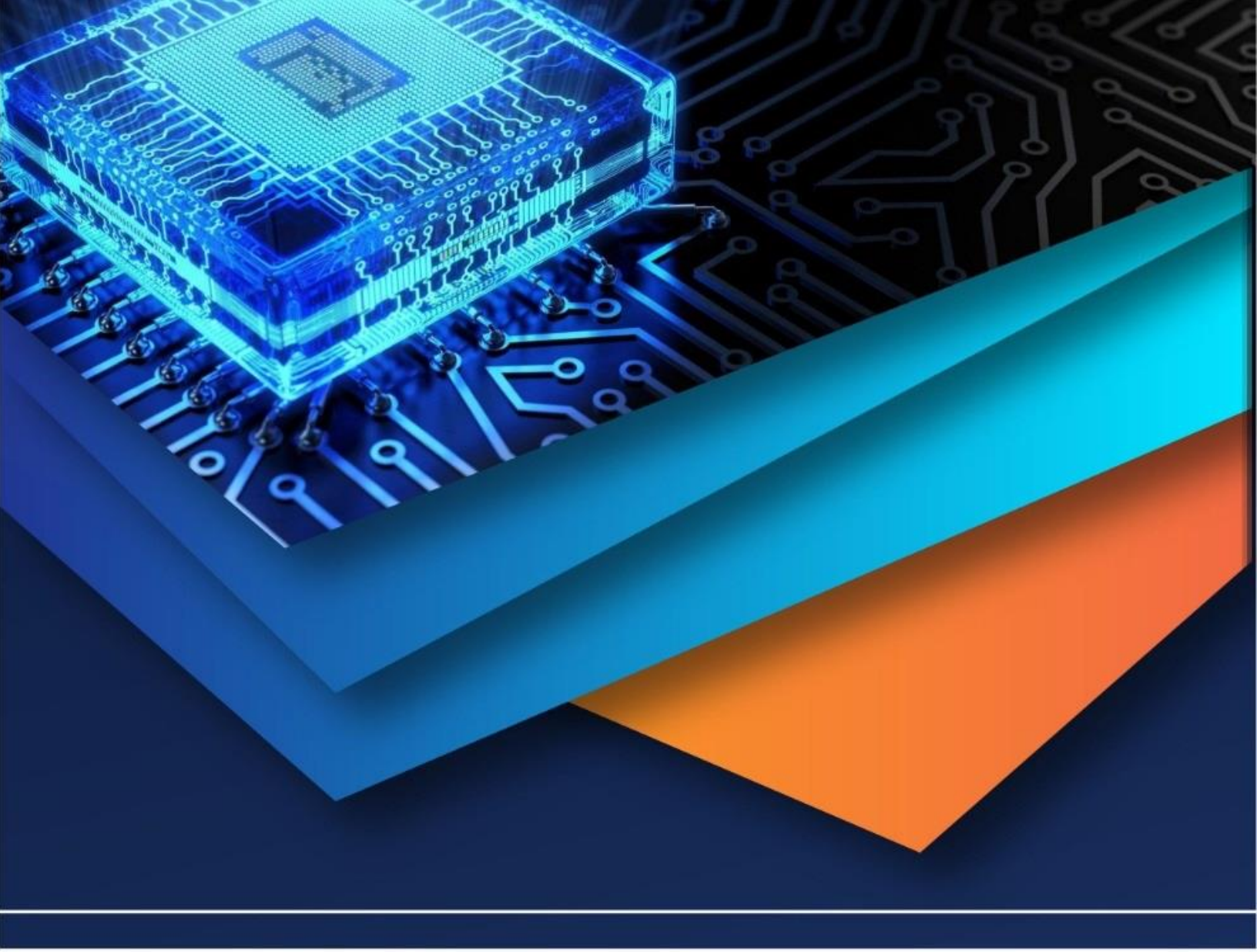
Fig 5: Mean localization error for BAT, FDBA and IDFDBA algorithms.

VI. CONCLUSION

In this paper we have presented various localization algorithms exist in literature and in addition to a comparison over remaining algorithms was described. Bat algorithm is the base algorithm it offers best localization needs and later on so many meta heuristic algorithms plays a Vitol role in this context. Fire fly driven bat technique shows good results in terms of minimization of errors and more over the proposed IDFDBA also provides some little improvement more compared to FDBA algorithm. Totally it signifies the importance of genetic algorithm approach towards finding the localization. In literature there are many challenges are existing to get scope of future research to find best localization for various applications.

REFERENCES

[1] Bulusu, Nirupama, John Heidemann, and Deborah Estrin. "GPS-less low-cost outdoor localization for very small devices." IEEE personal communications 7.5 (2000): 28-34.
[2] Niculescu, Dragos, and Badri Nath. "Ad hoc positioning system (APS) using AOA." IEEE INFOCOM 2003. Twenty-second Annual Joint Conference of the IEEE Computer and Communications Societies (IEEE Cat. No. 03CH37428). Vol. 3. Ieee, 2003.
[3] Priyantha, Nissanka B., Anit Chakraborty, and Hari Balakrishnan. "The cricket location-support system." Proceedings of the 6th annual international conference on Mobile computing and networking. 2000.
[4] Bahl, Paramvir, and Venkata N. Padmanabhan. "RADAR: An in-building RF-based user location and tracking system." Proceedings IEEE INFOCOM 2000. Conference on Computer Communications. Nineteenth Annual Joint Conference of the IEEE Computer and Communications Societies (Cat. No. 00CH37064). Vol. 2. Ieee, 2000.
[5] Sivakumar, S., and R. Venkatesan. "Meta-heuristic approaches for minimizing error in localization of WSNS." Applied Soft Computing 36 (2015): 506-518.
[6] Halim, A. Hanif, and I. Ismail. "Bio-Inspired optimization method: A review." NNGT Journal: International Journal of Information Systems 1 (2014): 1-6.
[7] Singh, Shailendra, and Ashok Kumar. "Novel optimal deployment of sensor nodes using bio inspired algorithm." 2014 IEEE International Conference on Advanced Communications, Control and Computing Technologies. IEEE, 2014.
[8] Sassi, Hichem, Tawfik Najeh, and Noureddine Liouane. "A selective 3-anchor DV-Hop algorithm based on the nearest anchor for wireless sensor network." International Journal of Electronics and Communication Engineering 8.10 (2014): 1756-1760.
[9] Han, Guangjie, et al. "A survey on mobile anchor node assisted localization in WSNS." IEEE Communications Surveys & Tutorials 18.3 (2016): 2220-2243.
[10] Chen, Min-Xiou, and Yin-Din Wang. "An efficient location tracking structure for WSNS." Computer Communications 32.13-14 (2009): 1495-1504.
[11] Zhang, Qing-guo, and Meng Cheng. "A node localization algorithm for wireless sensor network based on improved particle swarm optimization." Mechatronics and Automatic Control Systems. Springer, Cham, 2014. 135-144.
[12] Doherty, Lance, and Laurent El Ghaoui. "Convex position estimation in WSNS." Proceedings IEEE INFOCOM 2001. Conference on Computer Communications. Twentieth Annual Joint Conference of the IEEE Computer and Communications Society (Cat. No. 01CH37213). Vol. 3. IEEE, 2001
[13] Gondhi Navabharat reddy, sruthi setlam,D.Kiran kumar, A.Navya,Natasha Saude. ‘’ Genetic algorithms for localization in WSN’’. IJITEE,Vol-9,2397-2401.
[14] The Morgan Kaufmann Series in Networking Series Editor,David clark,M.I.T ‘’ WSNS’’2004.
[15] Paul, Anup Kumar, and Takuro Sato. "Localization in WSNS: A survey on algorithms, measurement techniques, applications and challenges." Journal of Sensor and Actuator Networks 6.4 (2017): 24.
[16] Stoleru, Radu, Tian He, and John A. Stankovic. "Range-free localization." Secure Localization and Time Synchronization for Wireless Sensor and Ad Hoc Networks. Springer, Boston, MA, 2007. 3-31.
[17] Singh, Munesh, and Pabitra Mohan Khilar. "Mobile beacon based range free localization method for WSNS." Wireless Networks 23.4 (2017): 1285-1300.
[18] Niculescu, Dragoş, and Badri Nath. "DV based positioning in ad hoc networks." Telecommunication Systems 22.1-4 (2003): 267-280.
[19] Bulusu, Nirupama, John Heidemann, and Deborah Estrin. "GPS-less low-cost outdoor localization for very small devices." IEEE personal communications 7.5 (2000): 28-34.
[20] Singh, Munesh, Sourav Kumar Bhoi, and Pabitra Mohan Khilar. "Geometric constraint-based range-free localization scheme for WSNS." IEEE Sensors Journal 17.16 (2017): 5350-5366.
[21] Yang, Xin-She, and Xingshi He. "Bat algorithm: literature review and applications." International Journal of Bio-inspired computation 5.3 (2013): 141-149.



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