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Performance Evaluation of Localization Technique In Wireless Sensor Network

Urvashi Singh, Manish kumar Jha
Mody Institute of Technology & Science Lakshmangarh, 332311, Rajasthan, India
Department of ECE, Faculty of Engineering & Technology
urvashisingh455@gmail.com
Mody Institute of Technology & Science Lakshmangarh -332311, Rajasthan, India
Department of ECE, Faculty of Engineering & Technology
manishkjhaa@gmail.com

Abstract—*This The process of estimating the geographical location of sensor nodes, called localization is an important research area in WSN. Accurate localization or tracking of wireless device is a crucial requirement for many emerging location aware systems. Fields of application include search & research, medical care, intelligent transportation, location based billing, security, home automation, industrial monitoring and control, location-assisted gaming, and social networking. This work attempts to deal with Classical Multidimensional Scaling (CMDS) technique to estimate the mapping of nodes. Further mapping is done with Neural network (NN) to further improve the accuracy of estimated node position. Comparison results show improved localization with NN implementation.*

Keywords- Wireless sensor nodes, Classical Multidimensional Scaling, Neural Network.

I. INTRODUCTION

Wireless sensor networks (WSNs) consists of small, low cost, smart sensor nodes which are interconnected wirelessly by a transceiver in a network. With recent advancement in MEMS, these network became increasingly available in various fields such as medical, bush fire detection, defence, wildlife monitoring etc. Mostly in all applications it is necessary to know the origin of an event i.e. location of sensor nodes. This process is called localization. It is an estimation of nodes coordinates by applying various algorithms. In WSNs two kind of nodes are placed one is anchor nodes who already know their position using laser device and the other nodes are sensor nodes which estimate their position using anchor nodes. Localization gains importance because of random deployment of WSN nodes in hazardous environments such as: volcanic eruption, disaster rescue, battle field surveillances. These places of node deployment are restricted for human intervention. Based on location awareness of nodes, energy efficient routing is required to prolong network life after network formation. Some other device like GPS is also used for location estimation . But practically it cannot be used as it increases the size & cost of the sensor, it is not suitable for indoor and underwater networks due to LOS condition requirement. Localization mechanism is broadly divided into two major categories such *(a)* range based techniques *(b)* range free technique. Range based technique estimate distance/angle information between two sensor nodes. Some of the techniques involved are: Time Difference of Arrival (TDoA), Time of Arrival (ToA), Angle of Arrival (AoA), Received Signal Strength Indicator (RSSI). Range free technique estimate distance or angle information using radio connectivity information between two sensor nodes. Some range free techniques are Centroid, Approximation Point In Triangle (APIT), Multidimensional Scaling (MDS) [1-2]. Range based techniques are costly, require extra hardware, consume additional energy, much complicated, etc. On the other hand range free techniques are independent of hardware and thus are cost effective [3].

The remainder of this paper are as follows: Section II discuss related work, section III describe Classical Multidimensional (CMDS) followed neural network in section IV. Section V elaborate the implementations and result along with conclusion and future direction in section VI.

II. RELATED WORK

Yi Shang *et al.* in [4] proposed MDS-MAP algorithm that uses connectivity information - who is within communication range of whom - to derive location of nodes in a network. Results demonstrate that given algorithm is more robust to measurement error than previous proposals, especially when nodes are positioned relatively uniformly throughout the plane. Georgious Latsoudas *et al*. in [5] proposed a two-stage MDS algorithm that employs an algebraic initialization procedure followed by gradient descent. The algebraic initialization step is based on the Fastmap algorithm [6], borrowed from the database literature. Fastmap is a linear-complexity mapping tool, which is, however, sensitive to measurement errors. Ali Shareef *et al*. in [7], indicate that neural networks are a viable option for solving localization problems. They qualitatively compare the performance of three different families of neural networks: Multi-Layer Perceptron (MLP), Radial Basis Function (RBF), and Recurrent Neural Networks (RNN), then compared the performances of their network with two of the Kalman Filter which are traditionally used for localization. Their result shows that the RBF neural network has the best accuracy in localizing, however it also has the worst computational and memory resource requirements. The MLP neural network, on the other hand, has the best computational and memory resource requirements. The works so far have not considered localization accuracy comparison between CMDS and NN approach which is the prime objective of this work.

III. CLASSICAL MULTIDIMENSIONAL SCALING (CMDS)

Multidimensional Scaling (MDS) technique is used for geometric configuration of nodes with minimum of three anchor nodes. MDS technique are of various types such as CMDS, Replicated MDS, Weighted MDS, deterministic and probabilistic MDS. This work has been implemented with CMDS technique. In this technique single distance matrix between sensor nodes is used to estimate node position [6,8].

A. *Algorithm for CMDS*

- Compute element wise squared distance matrix $P = D.D.$
- Compute double centering version of above obtain matrix P
  $$B = -\tfrac{1}{2} JPJ$$
- J is the centering operator and N is the number of sensor nodes.
  $$J = I - ee^T / N$$
- Compute eigen value decomposition
  $$B_r = U_r V U_r^T.$$
- Approximation node coordinate in *m* dimension is
  $$U_r V_r \wedge \frac{1}{2}.$$

In our research we analyze our results using *Stress* function. which is evaluated using estimated nodes position and the position obtain using CMDS & NN.

The degree of inaccuracy called *stress function*.

B. *Formulae for stress*

- $$rawstress = \sum_{i,j} (d_{ij} - d_{ij}^o)^2$$

Normalization Factor (sum of squared deviation from mean)

$$Stress = \sqrt{\frac{rawstress}{NF1}}$$

IV. NEURAL NETWORK

In neural network, neurons are connected together with weighted connections following a certain structure. Each neuron has an activation function that describes the relationship between the input and output of the neuron. Learning is viewed as the establishment of new connections between neurons or the modification of existing connections.

In this work "newcf" NN is choosen for the localization of nodes as shown in figure 1. Newcf network is a Cascaded - forward network consisting of N1 layers using DOTPROD weight function, NETSUM net input function, and the specified transfer function. The first layer has weight coming from the input. Each subsequent layer has weight coming from the input and all previous layers. All layers have biases.

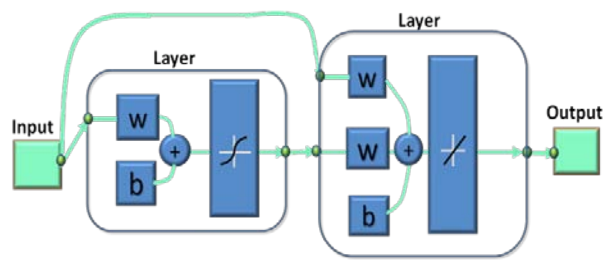

Figure 1 Newcf neural network

V. IMPLEMENTATION RESULTS

The figure 2 and figure 3 shows the implementation of CMDS and with neural network (NN) for 20 nodes and 30 nodes respectively. The graphs shows the estimated node position as well as position obtained after CMDS and NN implementation. Above techniques were implemented in MATLAB. Average stress value obtained for 20 & 30 nodes are 0.4538 & 0.3374 for estimated node position and position obtained after CMDS respectively. The corresponding stress value for NN implementation for 20 & 30 nodes using NN are 1.390482623525759e-011& 1.576493483948107e-012. Figure 4 shows the plot of stress with 20 iterations for 20 and 30 nodes estimated position and CMDS technique. Figure 5 shows plot of stress obtained with 20& 30 nodes with 20 iterations for NN implementation. We observe that stress value obtained is less with CMDS implementation compared to estimated node position and least with NN technique.

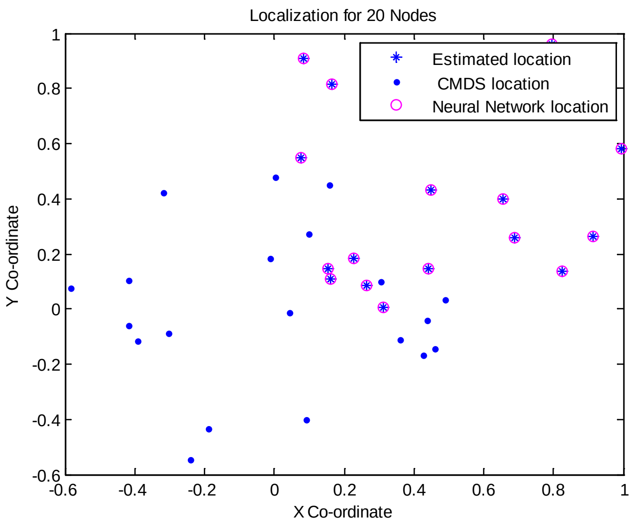

Figure. 2 Localization of 20 Nodes

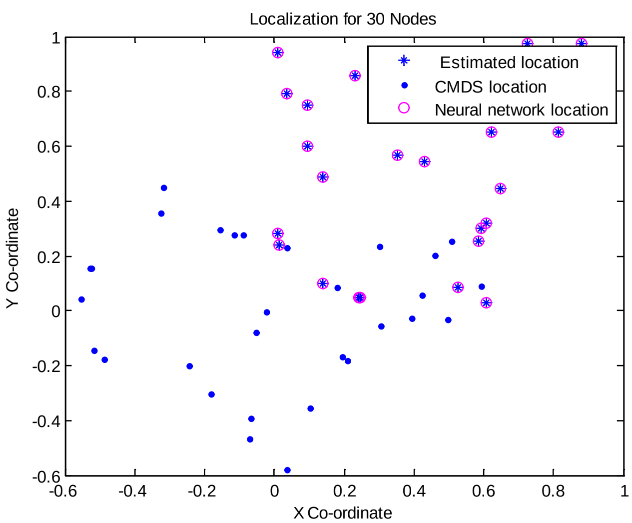

Figure. 3 Localization of 30 Nodes

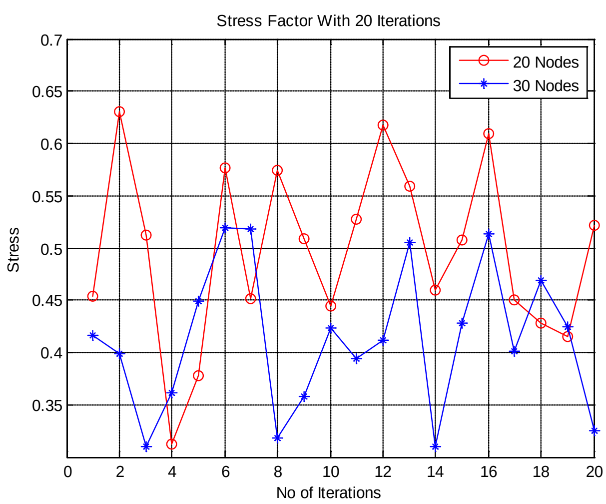

Figure 4. Stress factor in CMDS for 20 & 30 nodes with 20 iterations

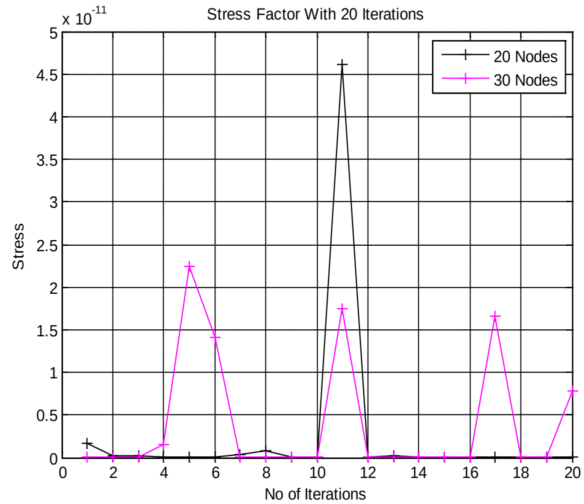

Fig
ure. 5 Stress factor in NN with 20 iterations

VI. CONCLUSION & FUTURE WORK

In this paper we have implemented localization using CMDS technique and NN. The stress is evaluated for determining the accuracy in localization. In this work, result obtained after CMDS (coordinates of nodes) is given to the input of "newcf" NN, which give almost negligible stress, and shows a good localization result of nodes with NN technique compared to CMDS technique. As NN require higher memory and additional hardware, it increases the size & cost of the sensor, that may be a deterrent where small size of sensor nodes is of prime importance. However, accuracy obtained with NN technique is very high.

Some important open issues in localization for future are [9] :Robust algorithm for mobile sensor networks, Attack the challenges of Information Asymmetry, Finding localization algorithm in three dimensional space.

REFERENCES

[1] Samira Afzal “A Review of Localization Techniques for Wireless Sensor Networks", Journal of Basic and Applied Scientific Research, 2(8), 2012, pp.7795-7796.

[2] Minhan Shon, Minho Jo, Hyunseung Choo, "An interactive cluster based MDS localization scheme for multimedia information in wireless sensor network", Computer communications, Volume. 35, Issue.15, 1 September 2012, pp.1921-1929, Elsevier publication(www.science.com).

[3] Rongbiao Zhang · Lili Zhang · Youbing Feng, "Very Low Energy Consumption Wireless Sensor Localization for Danger Environments with Single Mobile Anchor Node", Wireless Pers Commun (2008) 47:497–521 DOI 10.1007/s11277-008-9496-z, Published online: 12 June 2008 © Springer Science+ Business Media, LLC. 2008.

[4] Yi Shang, Wheeler Ruml, Ying Zhang, Markus P. J. Fromherz, "Localization from Mere Connectivity", Proceeding MobilHoc '03 Proceedings of the 4th ACM international symposium on Mobile ad hoc networking & computing, pp.201-212, ACM New York, NY, USA© 2003.

[5] Georgios Latsoudas, Nicholas D.Sidiropoulos, "A Fast and Effective Multidimensional Scaling Approach for Node Localization in Wireless Sensor Networks", IEEE transaction on Signal Processing, Volume.55, No.10, October 2007, pp.5121-5127.

[6] C. Faloutsos and K.-I. Lin, "FastMap: A fast algorithm for indexing, data-mining and visualization of traditional and multimedia datasets," in Proceeding. ACM SIGMOD, 1995, Volume. 24, no. 2, pp. 163–174.

[7] A Shareef, Y. Zhu and M. Musavi, "Localization using neural networks in wireless sensor networks", Proceedings of ACM first International Conference on Mobile Wireless Middleware, Operating Systems, and Applications (Mobileware), Innsbruck, Austria, February 2008.

[8] Rashmi Agrawal, Brajesh Patel, "Localization in wireless sensor network using MDS", International Journal of Smart Sensors and Ad Hoc Networks (IJSSAN) ISSN No. 2248-9738 Volume.1, Issue-3, 2012, pp. 26-31.

[9] Amitangshu Pal. "Localization algorithm in WSN: current Approaches and future challenges*"*. Network Protocols and Algorithm ISSN 1943-3581 volume.2, No.1, pp.47-73, 2010.