

# Performance evaluation of node localization techniques in heterogeneous wireless sensor network

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## Abstract:

Localization algorithms tailored for multihop heterogeneous wireless sensor networks (HWSNs), where nodes' transmission capabilities are different. They may fall into three categories: Measurement-based, Heuristic, and Analytical. Measurement-based algorithms exploit the measurements of the received signals' characteristics such as the received signal strength (RSS) in Heuristic algorithms; most of algorithms are based on variations of DV-HOP. And popular alternatives, more suitable for multi-hop WSNs, are the analytical algorithms which evaluate theoretically the distance between any two consecutive intermediate nodes. This paper involves calculation of received signal strength based on RSS technique and calculation of distance between two nodes based on DV HOP Technique. Further we can observe that if we increase the distance between nodes received signal strength decrease.

**Key words:** Heterogeneous wireless sensor networks (WSNs), localization, multihop, node connectivity, received signal strength (RSS), energy harvesting (EH).

## Introduction:

In recent years the field of wireless sensor networks has attracted considerable interest among numerous research groups all over the world. Sensor networks are deployed to sense, monitor, and

report events of interest in a wide range of applications like Military, health care, animal tracking, and environment monitoring such as temperature, light, pressure etc.[4] It is an infrastructure less communication protocol, so it does not have a fixed hardware design. It is a set of small and low-cost sensor nodes often equipped with small batteries. The latter are often deployed in a random fashion for different applications.[4] Heterogeneous wireless sensor network is a network of nodes having different transmission capabilities

Node Localization is defined as the deployment of the sensor nodes at known locations in the network.[2] It is an estimation of the positions of the sensor nodes in the network. It reduces power consumption and number of collisions, providing better accuracy. During node localization power consumption, density of nodes, coverage area of cluster, number of data units for transmission, transmission power must be taken into consideration.

Clustering is widely adopted in WSNs, where the entire network is divided into multiple clusters. Each cluster has one cluster head (CH) and it is responsible for data aggregation. Instead of direct communication with the sink, all the member nodes in one cluster send data to the CH. In this way, the traffic load can be reduced. It has the advantages of low energy consumption, simple routing scheme and good scalability, and it reduces the energy problem to

some extent. Clustering depends on network type that is homogeneous or heterogeneous.[2] Homogenous clustering refers to cluster of similar kind of nodes while heterogeneous network consist of different nodes with different parameters like battery requirement, transmission power, coverage area etc.here we calculate received signal strength (RSS) by using transmission power and links distance.

### Literature survey

Ahmad El Assaf, Slim Zaidi, Sofiene Affes, Nahi Kandil in "Low-Cost Localization for Multihop Heterogeneous Wireless Sensor Networks". Proposed a novel low-cost localization algorithm tailored for multihop heterogeneous wireless sensor networks (HWSNs) where nodes' transmission capabilities are different. They developed two different approaches to derive the expected hop progress (EHP). Exploiting the latter, they also propose a localization algorithm that is able to accurately locate the sensor nodes owing to a new low-cost implementation. Furthermore, they develop a correction mechanism, which complies with the heterogeneous nature of wireless sensor networks (WSNs) to further improve localization accuracy without incurring any additional costs.

S. Hong, D. Zhi, S. Dasgupta, and Z. Chunming in "Multiple source localization in wireless sensor networks based on time of arrival measurement" stated the localization of multiple signal sources based on sensors performing time-of-arrival (TOA) measurement in wireless sensor networks. Moving beyond they widely studied single source localization problem, concurrently active multiple sources substantially complicate the problem since anchored sensor nodes are unaware of association's between measured signals and source nodes. At the same time, as the total number of possible source-measurement associations grows exponentially with the number of sensor nodes, it is inefficient to attempt conventional single-source localization algorithm for each possible association in a brute-force manner. In this work, they address this difficult problem from a joint optimization perspective. Specifically, they consider simultaneous estimation of source-measurement associations and the source locations, in addition to finding the initial signal transmission time. This joint optimization problem includes both discrete and continuous variables. They stated an efficient three-step algorithm that progressively simplifies the original problem through convex relaxation and sensible approximations. Their algorithm demonstrates results comparable to a genie-aided method that utilizes known source-measurement associations

Xiao, B. Xiao, J. Cao, and J. Wang in "Multihop range-free localization in anisotropic wireless sensor networks: A pattern-driven scheme," proposed a pattern-driven localization scheme, which is inspired by the observation that in an anisotropic network the hop count field propagated from an anchor exhibits multiple patterns, under the interference of multiple anisotropic factors. They stated that their localization scheme therefore for different patterns adopts different anchor-sensor distance estimation algorithms. The average anchor-sensor distance estimation accuracy of their scheme, as demonstrated by both theoretical analysis and extensive simulations, is improved to be better than  $0.4r$  when the average sensor density is above eight, and the sensor localization accuracy thus is approximately better than  $0.5r$ . This localization accuracy can satisfy the needs of many location-dependent protocols and applications, including geographical routing and tracking. Compared with previous localization algorithms that declare to tolerate network anisotropy, their localization scheme excels in 1) higher accuracy stemming from its ability to tolerate multiple anisotropic factors, including the existence of obstacles, sparse and non-uniform sensor distribution, irregular radio propagation pattern, and anisotropic terrain condition, 2) localization accuracy guaranteed by theoretical analysis, rather than merely by simulations, and 3) a distributed solution with less communication overhead and enhanced robustness to different network topologies.

Y. Wang, X. Wang, D. Wang, and D. P. Agrawal, in "Range-free localization using expected hop progress in wireless sensor networks," stated a novel range-free localization algorithm using expected hop progress (LAEP) to predict the location of any sensor in WSN of hop progress. WSN with randomly deployed sensors and arbitrary node density. By deriving the expected hop progress from a network model for WSNs in terms of network parameters, the distance between any pair of sensors can be accurately computed. Since the distance estimation is a key issue in localization systems for WSNs, the proposed range-free LAEP achieves better performance and less communication overhead as compared to some existing schemes like DV-Hop and RAW. In addition, we study the effect of anchor placement on the algorithm performance by deriving the corresponding mean position error range. Extensive simulations are performed and the results are observed to be in good agreement with the theoretical analysis.

### Proposed system:

The Proposed work will be implemented in following steps:

1. Performance evaluation of node localization using existing measurement based algorithm like Time of arrival (TOA), received signal strength (RSS).
2. Performance evaluation using heuristic algorithm like DV-HOP.
3. Performance evolution of proposed analytical algorithm and their comparison with the all above on the basis of following mentioned parameters.

Proposed work for dissertation consists of a novel three-step for localization algorithm Expected Hop Process (EHP). It is shown in following Fig1.flow chart

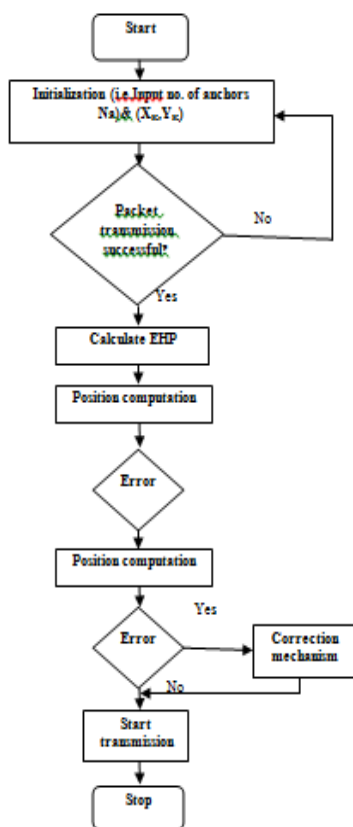


Fig 1: flowchart of proposed work

### Explanation

#### Localization

Localization in WSN is complicated by the large number of parameters that need to be considered when designing a localization system for a particular WSN deployment. Among these parameters the

deployment method for the sensor network; the existence of a line-of-sight between sensor nodes and a remote, central point; the time required by the localization scheme; the presence of anchors in the network, and the density; the cost for localization, represented by additional hardware (form factor) and energy expenditure for message transformation. The nodes can be randomly deployed or by each node giving location.

Here we used NS2 software for simulation

Here we deploy the nodes randomly for example we consider the number of nodes 5. According to DVHOP, the distance vector routing Communication is hop by hop by considering the distance

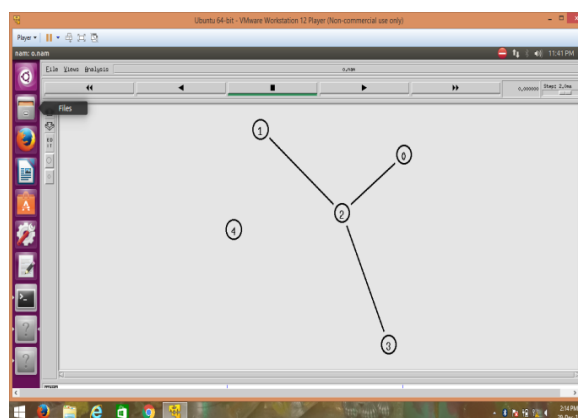


Fig 2: random node deployment

Nodes are deployed randomly in the particular area by giving X and Y coordinates and calculating the distance between the nodes.

#### Node Distance

Distance measurement formula:

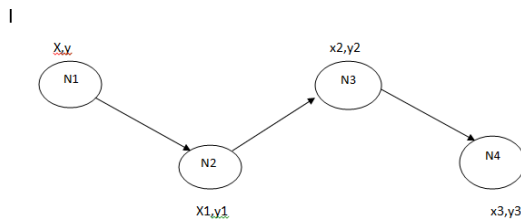
$$\left\{ (x-x_1)^2 + (y-y_1)^2 \right\}^{1/2}$$

Where (x,y) are the coordinates of first node and (x1,y1) are the coordinates of the second node.

So that by using this formula we can calculate the distance between the n numbers of nodes at a time.

Suppose we want to find out the distance between the 4 nodes n1, n2, n3, n4  
 Then the distance will be measured as distance from n1-n2, n2-n3 and at last n3-n4. we used 4 no of nodes then we get 3 distance outputs.

No of outputs = no of nodes - 1

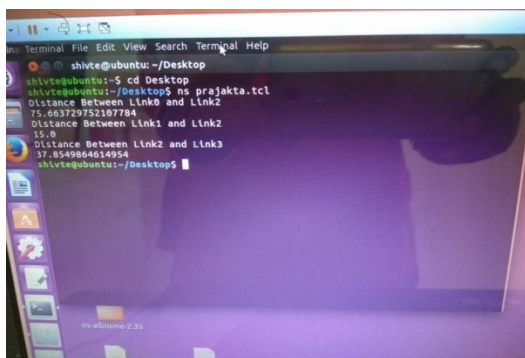


Below table shows outputs for Distance calculation

**Table 1.-**Distance calculation output:

Link s	Distance in meters
Between Node 0& Node 2	7 5 . 6 6
Between Node 1& Node 2	1 5 . 0 0
Between Node 2& Node 3	3 7 . 8 5

Screen shot of output terminal window for links calculation is as below



**Fig 3:** screen shot for distance calculation output

**Received signal strength (RSS)**

Also se can calculate received signal strength (RSS) for transmission efficiency. This technique involves measuring the power of an incoming signal at a receiving node, based on the known transmitted power; the effective propagation loss can be calculated. Unfortunately, due to the probable presence of noise and interference, the distance's estimate would be far from being accurate, thereby leading to unreliable localization accuracy.

Formula for RSS

Transmission power/distance between nodes

Here we give the transmission power 0.5J, 1J, 100Jetc

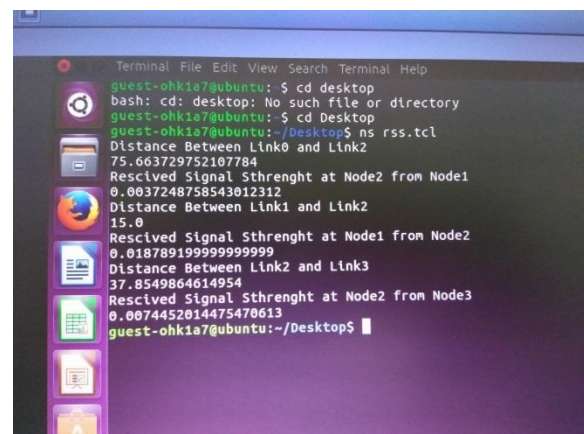
Also we can select area 100\*100m<sup>2</sup>

Below table shows outputs for links received signal strength

**Table 2.-**Received Signal Strength Output:

Link s	RSS In joules
Between Node 0& Node 2	0 . 0 0 3 7 2
Between Node 1& Node 2	0 . 0 1 8
Between Node 2& Node 3	0 . 0 0 7 4

Below screen shot shows outputs for given networks distance between nodes and received signal strength



**Fig 4:** Screen shot for distance and received signal strength output

### Conclusion:

Using basics of NS2 software we localized the wireless sensor nodes randomly. The communication links are established, the hop by hop communication observed depending on DVHOP localization techniques. The received signal strength (RSS) is calculated, Based on known transmitted power and distance between nodes. Further we conclude that if we increase the distance between nodes received signal strength decrease.

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