An Improved Approach for AOA/TOA using Linear Regression

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ABSTRACT:

There are various techniques which are previously proposed and implemented are available. These methods promise to calculate, AOA (Angle of Arrival) and TOA (Time of Arrival) accurately. Therefore, in order to design new method numerous of techniques and methods analyzed. To improve existing techniques for AOA (Angle of Arrival) and TOA (Time of Arrival), a new predictive technique is proposed. The proposed location estimation method uses mathematical expressions and statistical analysis based technique, which consume previous location pattern data and predict new position for mobile station (MS). This predictive technique is implemented using TCL scripts and NS2 simulation environment. Which is compared with previously available distance weighted method.

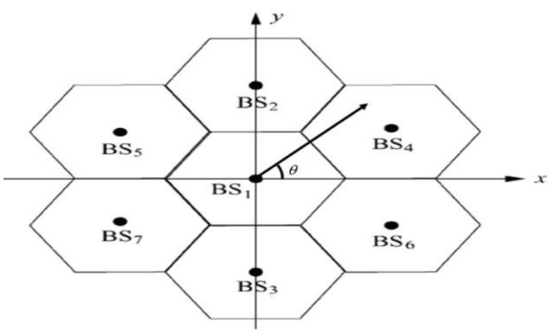
Key words

AOA (Angle of Arrival), TOA (Time of Arrival), Mobile station (MS).

1. INTRODUCTION

In search of finding best scheme for AOA (angle of arrival) estimation we study some papers and articles and we found that there a large amount of AOA (angle of arrival) estimation algorithms and methods are previously proposed, but most of them are not efficient and accurate method even more some methods are much expensive in implementation. This project is motivated by "Hybrid TOA/AOA Schemes for Mobile Location in Cellular Communication System" in this paper author propose a hybrid scheme for estimating the AOA (Angle of Arrival) for mobile location.

The model proposed according to the above given scenario, where only one BS (Base Station) is required to locate the MS (Mobile Station). In reality, due to NLOS (Non line of sight) propagation, both TOA (Time of Arrival) and AOA (Angle of Arrival) estimation contain errors. Thus more than one BS is required for MS location of reasonable accuracy. Here TOA (Time of Arrival) measurements from seven BS's and the AOA (Angle of Arrival) information at the serving BS is used to give a location estimation of the MS, as shown in Fig.



Let t_i denote the propagation time from the MS to BS_i and the coordinates for BS are given by $(X_i Y_i)$ = 1, 2…..7 the distances between BS_i and the MS can be expressed as

$$r_i = c.t_i = \sqrt{(x - X_i)^2 + (y - Y_i)^2}$$

Where (x, y) is the MS location and c is the propagation speed of the signals. In Fig, θ is the measured AOA (Angle of Arrival) from the serving BS with respect to a reference direction (x-axis) and defined as:

$$\theta = \tan^{-1} y/x$$

In order to achieve high accuracy of MS location with too few efforts previously proposed algorithm is applied in seven BS's as follows:

2. DISTANCE WEIGHTED METHOD

The weights can be dynamically adjusted with reference to the distance square between the estimated MS location and the average MS location. The detailed steps provided below.

1. Find all feasible intersection of the seven circles and a line.

2. The MS location is estimated by averaging these remaining feasible intersections, where
$X_N = \frac{1}{N}\sum_{i=1}^{N} X_i$ and $Y_N = \frac{1}{N}\sum_{i=1}^{N} Y_i$

3. Calculate the distance id between each remaining intersection (x_i, y_i) and the average location (x_N, y_N).
$d_i = \sqrt{(x_i - X_N)^2 + (y_i - Y_N)^2}$

4. Set the weight for i^{th} remaining feasible intersection $(d_i^2)^{-1}$. Then Mobile Station Location (x_d, y_d) is determined by

$$x_d = \frac{\sum_{i=1}^{N}(d_i^2)^{-1}.x_i}{\sum_{i=1}^{N}(d_i^2)^{-1}.} \;, y_d = \frac{\sum_{i=1}^{N}(d_i^2)^{-1}.y_i}{\sum_{i=1}^{N}(d_i^2)^{-1}.}$$

In the above given diagram author use only one base station and others are mobile station the complete circle form an angle of 2θ. And the moveable mobile stations are moving around the range of the base station. Suppose at any time t1 position of any mobile station is defined in the circle is given as (X_n, Y_n) .Where X_n is x coordinate of the MS and Y_n is Y coordinate of the MS.

3. PROPOSED ALGORITHM

The proposed scheme is a robust, efficient and accurate algorithm for finding geometric position of the mobile station. To achieve high performance and low cost AOA (Angle of arrival) estimation algorithm, a new method based on linear regression and adoptive error correction based scheme is proposed, which is derived using the help of previously proposed distance weighted methods. Linear Regression is a Technique to modeling the relationship between a scalar variable and one or more explanatory variable. The detailed steps for locating mobile station using distance weighted method with linear regression are:

1 We have all the feasible intersection of 7 BS's and a line.
2. The MS location is estimated by averaging this remaining feasible intersection.

$X_N = \frac{1}{N}\sum_{i=1}^{N} X_i$ and $Y_N = \frac{1}{N}\sum_{i=1}^{N} Y_i$

3.Using the line eq. y= m x + c

$$m = \frac{y_2 - y_1}{x_2 - x_1} \text{-------------------(i)}$$

$$c = y - \left(\frac{y_2 - y_1}{x_2 - x_1}\right) \text{-------------(ii)}$$

Then y is written as

$$y = c + \left(\frac{y_2 - y_1}{x_2 - x_1}\right) \text{--------(iii)}$$

And the angle is estimated using

$$\tan^{-1}(m) = \theta$$

From the above relation we have X_1, Y_1 and required to estimate X_2, Y_2 using linear regression method

$$y_i = x_i^T \beta \pm \epsilon_i$$

Where,

y_i =New distance from y axis

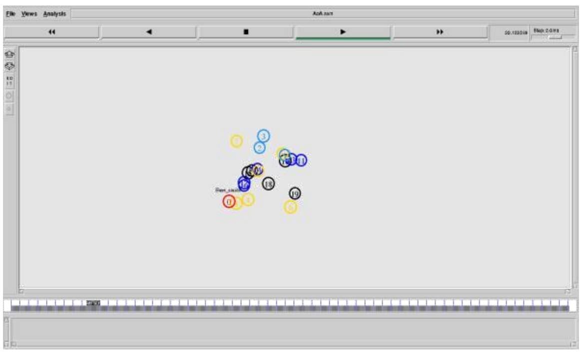
x= the previous path

β=angle

ϵ_i = error to adjust

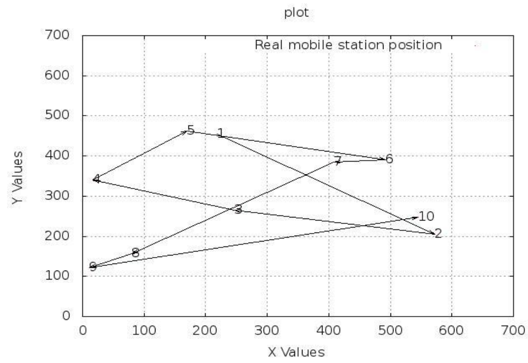
4. SIMULATION AND SCENARIO

In this network simulation in a single simulation scenario, where both algorithms are predicted the mobile node positions. In order to design the given simulation, a wireless network is constructed. Using the network simulator and mobility over node is provided using "random way" mobility is installed over each node. Finally using the distance weighted method and proposed technique the next node movement is estimated. After finalizing the network execution this provide the animation as given below



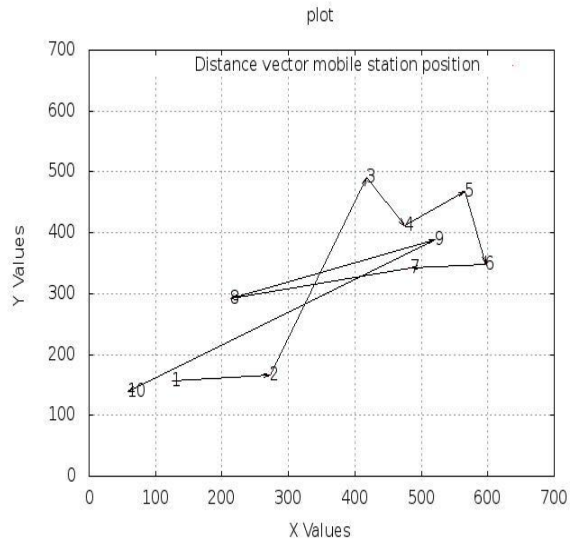
5. RESULT ANALYSIS

The position information which randomly generated for a node using random way mobility, the actual position of node is given as below



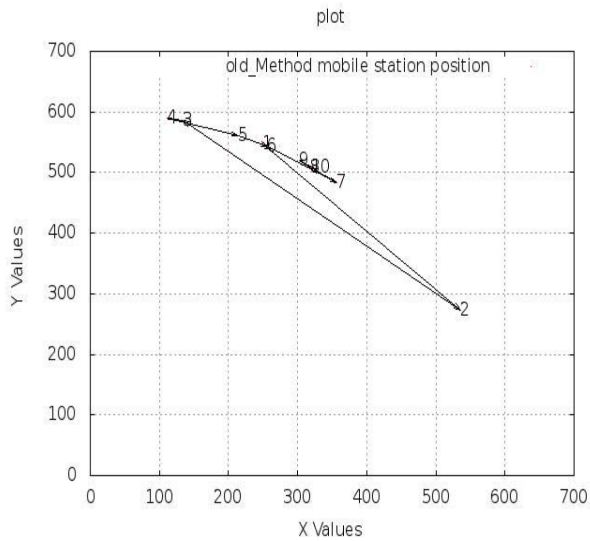
6. DISTANCE WEIGHTED METHOD

The position information which randomly generated for a node using Distance weighted method, given as below



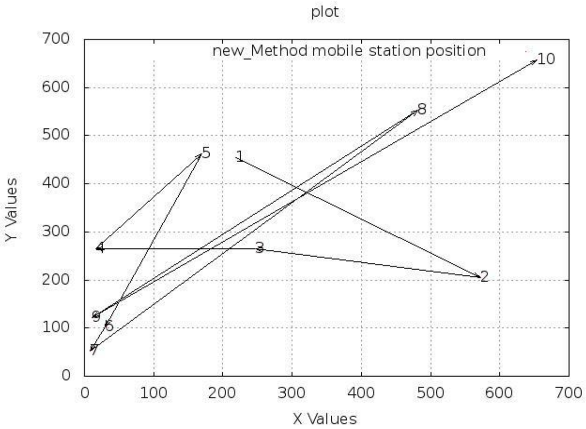
7. DISTANCE WEIGHTED METHOD WITH PROJECTILE PATH

The position information which randomly generated for a node using Distance weighted method with projectile, given as below



8. PROPOSED METHOD

The position information which randomly generated for a node using Distance weighted method with linear regression, given as below



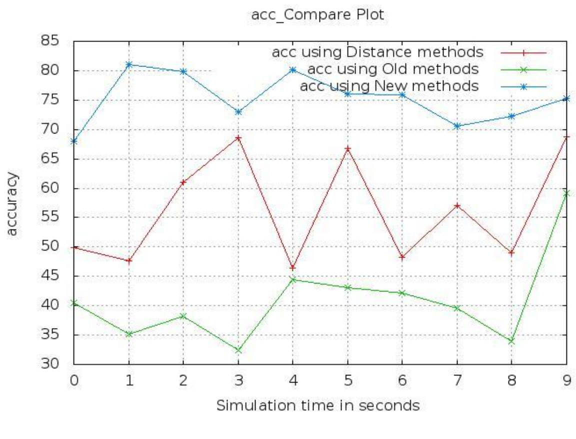
Accuracy

This section provides the comparative accuracy of the mobile node positioning which is based on number of results estimated during experimentation. In numerical analysis, accuracy is the nearness of a calculation to the true value

The accuracy of the mobile node is estimated using.

$$\text{Accuracy} = \frac{\text{Estimated Position}}{\text{Actual position}} \times 100$$

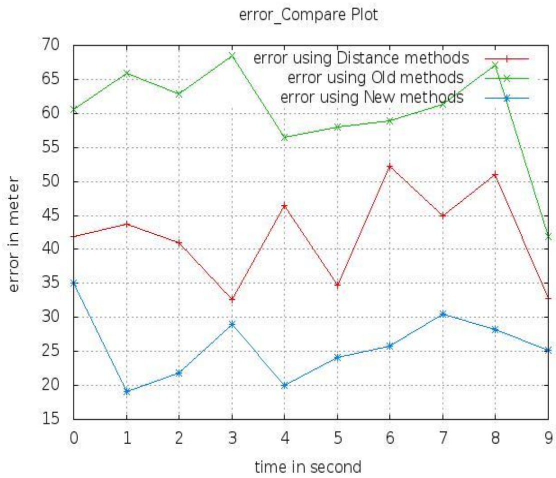
The accuracy of the system is given using the below graph



Error Rate

These performance parameters provide the values indicating how much difference actually exists in estimation of the accurate values which is calculated as

Error = 100 – Accuracy



9. CONCLUSION

The proposed work is intended to provide an efficient and effective method for mobile position estimation. There are two main categories of mobile position estimation first using the statistical methods and next predictive methods. The proposed work is an effort to enhance the previously available technique of mobile positioning. Using this technique previous pattern of mobile positioning data is analyzed and new mobile location is estimated. To improve the accuracy of position estimation error compensation methodology is provided. By which the algorithm adopt errors and correct them during calculation. The proposed method is adoptable and able to provide more accurate results as compared to previously given or available methods. In this proposed work is based on error correction and predictive methodology. The implementation of the proposed system is given by NS2 network simulator. And performance of the algorithm is calculated using different network scenarios, the estimated performance and results shows that the proposed scheme is able to provide more accurate mobile positions.

10. REFERENCES

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