Position Estimation of a Mobile XBee Node Using RSSI and MATLAB

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***Abstract*—This paper presents a method for estimating the position of a mobile node using received signal strength indicators (RSSI) from XBee modules and MATLAB-based signal processing. Experimental results demonstrate localization accuracy within 1 meters under outdoor conditions.**

***Index Terms*—RSSI, XBee, Localization, MATLAB, Wireless Sensor Networks**

I. Introduction

Wireless localization using RSSI measurements has become a popular approach due to its low cost and ease of deployment. XBee radios provide RSSI outputs that can be processed to estimate distances via path-loss models.

II. Methodology

A. RSSI Data Acquisition

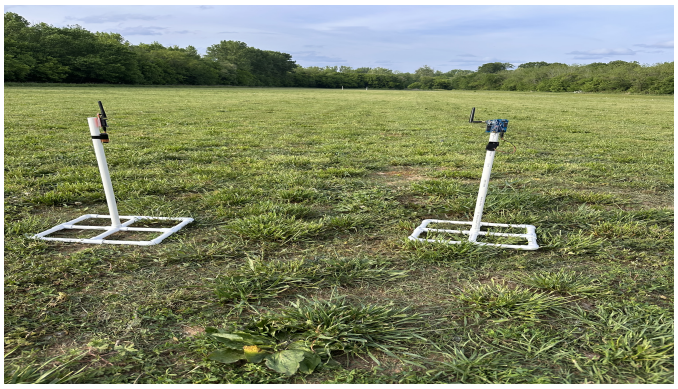
XBee modules were configured in API mode to transmit RSSI data between multiple anchor nodes and the target mobile node to a stationary coordinator at 2.4 GHz.

B. Distance Estimation

Using the log-normal path-loss model:

$$d = 10^{\frac{\text{RSSI}-\text{A}}{10\,n}},$$

where n is the path-loss exponent and A is the one meter RSSI obtained from calibration (See image below for one meter calibration).



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C. Position Computation in MATLAB

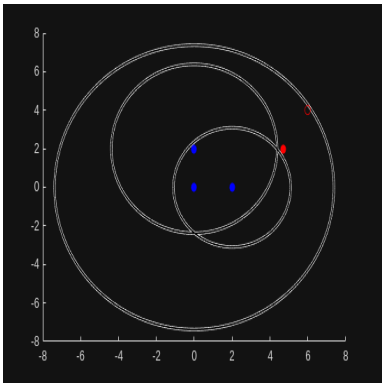
Trilateration was done by implementing a Matlab script written by Dr. Shue. An explantion of trilateration using RSSI and Matlab are in his 2017 paper "Utilization of XBee ZigBee modules and MATLAB for RSSI localization applications". I wrote two Matlab scripts. One to run the test and save data onto csv file. The other to read the file and perform trilateration.

III. Results

Actual Position (m)	Estimated Position (m)	X Error, Y Error(abs)
-2, 0	2.10, 1.12	4.10, 1.12
-2, 2	1.45, 1.92	3.45, 0.08
0, -2	1.76, 1.85	1.76, 3.85
0, 4	1.32, 2.41	1.32, 1.59
2, 2	2.15, 1.64	0.15, 0.36
4, 0	3.32, 1.09	0.68, 1.09
6, 4	4.69, 2.00	1.31, 2.00

TABLE I
Position estimation results.

Fig. 1. Actual Position vs. Estimated Position.



IV. Discussion

The localization error is higher when the mobile node is in the negative X or negative Y position. This could be due to multiple reasons such as the distance and position of the anchors or equipment malfunctions. More testing with different anchor arrangements, Xbee modules and antennas would pin point the issue.

V. Conclusion

We showed that RSSI could be used to find the position of a mobile node. In the future we plan on using machine learning algorithms to make the trilateration more accurate.