Comparison of 2D RSSI based WSN Multipath Faded Indoor Localization Algorithms

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I. INTRODUCTION

A lot of effort has already been put in research on indoor location-aware applications with wireless sensor networks (WSN). In a previous paper we presented a new 2D positioning algorithm for localization in a real life multipath environment [1] based on the linear relation between the received signal strength (RSSI) and the logarithm of the distance between the sender and the receiver [2]. A new algorithm can only find wide acceptance if it is proven to be better than the existing algorithms. In this paper we therefore implement as a reference a more conventional localization algorithm on our IBBT Wilab.t test bed and compare the test results. A first (and evident) criterion is the error on the position.

II. DESCRIPTION OF RESEARCH

Our localization algorithm [1] was the basis for our new Linear Regression based Fast Localization Algorithm (LiReFLoA). The major improvement is a better manipulation of the distance circles, which is now based on the regression model itself. In this paper we compare LiReFLoA with a more conventional algorithm based on the maximum likelihood relative location estimation algorithm (MLRLE) [3]. MLRLE differentiates the cost function and then uses the (iterative) conjugate gradient method described in [4]. For simplicity we here use the more direct method with grid points. The cost function is a sum of squared logarithms of the squared quotient of distances and decreases when the calculated position is closer to the target. Therefore the grid point having the smallest value of this cost function is selected as the estimated position. LiReFLoA more efficiently uses and manipulates circles.

A cumulative distribution plot of the position error shows almost no difference in position error for both algorithms, but reveals an outlier in the adapted MLRLE algorithm. This is due to the fact that for this outlier all RSSI-measurements are too low and thus all measured distances are too high. Thanks to elimination of bad distance circles, this outlier is not present in LiReFLoA.

III. CONCLUSIONS

Our positioning algorithm LiReFLoA has comparable errors to the adapted MLRLE. It is however less sensitive to outliers.

REFERENCES

[1] F. Vanheel, J. Verhaevert and I. Moerman, "On the Concept of RSSI based Indoor WSN Localization using Statistical Tools," *16th URSI Forum of the Benelux*, Brussels, Belgium, 18 May 2010.

[2] F. Vanheel, J. Verhaevert and I. Moerman, “Study on Distance of Interference Sources on Wireless Sensor Network,” *European Microwave Conference (EuMC),* Amsterdam, The Netherlands, pages EuMC10-1.1-4, 27-31 October 2008.

[3] N. Patwari, A. O. Hero, M. Perkins, N. S. Correal, and R. J. O'Dea, "Relative location estimation in wireless sensor networks," *IEEE Trans. Signal Processing*, vol. 51, pp. 2137-2148, 2003.

[4] J. R. Shewchuk, “An Introduction to the Conjugate Gradient Method Without the Agonizing Pain,” [Online], Available: http://www.cs.cmu.edu/~quake-papers/painless-conjugate-gradient.pdf