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The Geo-n Localization Algorithm

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ABSTRACT

We present Geo-n, a highly precise distance based localization algorithm which is very resilient to outliers and to a wide range of geometrical constellations between unlocalized nodes and anchors. In our simulations and our real world experiments with several runs in populated office buildings it provides a much better localization precision than the algorithms we compare to: multilateration with a linear least squares solver (LLS) or with a non linear least squares solver (NLLS) and more resilient algorithms for indoor localization like ICLA or AML.

The algorithm has three main steps. First, all intersection points between every pair of circles induced by *n* anchor coordinates and distance measurements are generated, resp. approximated if the pair is separate or one circle is contained within the other. Next, only intersection points contained in *n-2* circles are kept to remove farther intersection points. The points whose sum of distances to all other points is larger to the median of all sums are eliminated. Finally the position of the unlocalized node is estimated as the weighted centroid of the remaining intersection points.

We compare our algorithm using simulation and real world deployments. We used a deployment of 17 anchors covering a whole floor in our office building and measured distances with a nanoPAN 5375 transceiver on MSB-A2 sensor nodes. The nanoPAN achieved a ranging precision of around 2.85 m in average and the RMSE was 4.32 m. The average localization error of all experiments shows that Geo-n (1.83m) outperformed all other algorithms used: ICLA (4.25m), NLLS (4.49m), AML (4.96m), and LLS (8.92m). Furthermore, our algorithm is resilient to outliers in the distance error.

We propose Geo-n as a new general purpose algorithm for indoor localization. Like NLLS, its spatial error distribution is very homogeneous. However, Geo-n is much more robust and achieves lower average error while retaining reasonable computational complexity.

KEYWORDS: Indoor Localization, Wireless Sensor Networks, Lateration