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Adaptive Anchor Weighting for Improved Localization with Levenberg-Marquardt Optimization

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Abstract : This paper introduces an iterative and weighted localization method that utilizes a unique cost function formulation to significantly enhance the performance of positioning systems. The system employs locators, such as Gateways (GWs), to estimate and track the position of an End Node (EN). Performance is evaluated relative to the number of locators, with known locations determined through calibration. Performance evaluation is presented utilizing low cost single-antenna Bluetooth Low Energy (BLE) devices. The proposed approach can be applied to alternative Internet of Things (IoT) modulation schemes, as well as Ultra WideBand (UWB) or millimeter-wave (mmWave) based devices. In non-line-of-sight (NLOS) scenarios, using four or eight locators yields a 95th percentile localization performance of 2.2 meters and 1.5 meters, respectively, in a 4,305 square feet indoor area with BLE 5.1 devices. This method outperforms conventional RSSI-based techniques, achieving a 51% improvement with four locators and a 52 % improvement with eight locators. Future work involves modeling interference impact and implementing data curation across multiple channels to mitigate such effects.

Keywords : lateration, least squares, Levenberg-Marquardt algorithm, localization, path-loss, RMS error, RSSI, sensors, shadow fading, weighted localization
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