An Indoor Localization Algorithm in a Small-cell LED-based Lighting System

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Localization techniques for indoor environments are increasing as a new class of services, called as Location Based Services, providing positioning information to track and navigate users in a location-aided environment. The use of wireless technology, like IEEE802.11x and RFID, has acted as the main solution for indoor localization services. However, the rapid development of new "white" LED materials in the visible spectrum has been given for consideration of visible light as novel communication medium, in addition to illumination.

In this paper, we propose a simple, while effective, method for indoor localization service provided by infrared LEDs. The estimation of the mobile device's position inside a grid (*e.g.*, a conference room) is provided through a set of four LED-based transmitters uniformly deployed in the room. The proposed technique exploits information of the impulse responses to determine the estimations of mobile terminal's positions.

This approach has been tested via simulation results, carried out via Candles software, by assuming a mostly realistic scenario, comprised of a room as a grid of uniformly displaced receivers, and four transmitters. A *power map* of the transmitters in the room and the time samples for the impulse responses has been recorded. By comparing the power values in the map, it is possible to estimate the mobile terminal's positions.

We simulated a known mobile terminal's path inside the room, and obtained the impulse responses from each transmitter, then compared to the values in the *power map*. The algorithm is a cyclic process, returning a number of available receivers, which approximate the mobile node's positions. For a number of receivers greater than two, the algorithm calculates the sums of the differences between impulse responses' peaks at the receiver sides, and those in the map. The mobile terminal's position is estimated in the middle between two receivers with lowest sum.