

A Geometric Approach to Device-Free Motion Localization Using Signal Strength

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Abstract:

In this work we describe and evaluate an approach to accurately infer the position in a building where human motion occurs. Our approach does not require the humans to wear any type of device. Such passive mobility localization is applicable in a wide variety of application domains, including those in security, human workflows, and systems management. We position human motion using the change in standard deviation of the received signal strength between stationary transmitters and receivers at known locations. Using a modest transmission rate of once per second, we localize the motion at 2-5 second timescales using a lines-intersecting-tiles method where each line is a straight path between a transmitter and receiver. Our algorithm returns a set of rectangular tiles where the motion has occurred. We experimentally validate our scheme in two different building environments, one containing a cluttered space and a second with a more open arrangement. We show good results for basic mobility detection, with a low number of false positives and negatives. We show that we can localize human motion with a median error of less than 20 ft. We can achieve these results with a modest density of inexpensive active RFID tags, one per 500 ft.². We also explored how our results degrade with reduced density of transmitters and receivers, and show our mobility detection rates remain good although the geometric precision of the results degrades in line with the density of transmitters.