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Fingerprinting Based Localisation Revisited

a rigorous approach for comparing RSSI measurements coping with missed access points and differing antenna attenuations

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ABSTRACT

Fingerprinting based localisation systems rely on taking a radio map of the environment and determine the position of the device by comparing this map to its current measurements. Therefore the performance of any such system heavily relies on the accuracy of this comparison. Typically two problems arise: first, access points can be missed in a scanning cycle both during the fingerprinting phase as well as during the localisation phase and second, if different devices are used for fingerprinting and for localisation their received signal strengths might not be the same due to differing antenna attenuation. A successful comparison function has to cope with both of these issues yielding repeatable high likelihoods for measurements taken in the same location while at the same time providing sufficiently high discrimination for measurements taken in different locations.

In this paper we will propose such a likelihood observation function based on rigorous assumptions. Like most approaches we will compare RSSI values based on squared Euclidean distance of the log energies, which is essentially a Gaussian assumption on the distribution of the measurement error justifiable by arguments like maximum entropy or the law of large numbers acting on multiple additive error sources. However, this naive approach suffers from the varying dimensionality of the log-energy space caused by missing access points in the measurement. In order to overcome this in a rigorous manner we propose to model the access point pickup probabilities using Gibbs distributions enabling the introduction of rigorously motivated penalties for these dimension mismatches. As a further extension of the likelihood observation function we also propose to make it invariant to differences in antenna attenuation by estimating these explicitly from the log-energy observations and using the minimised squared observation residuals as invariant distance measure instead. We will discuss the properties of this improved likelihood observation function and compare its performance in a particle filter based WiFi localisation system.

KEYWORDS: WiFi localization, Fingerprinting, RSS based localization