

# Poster: Impact of Ground Truth Errors on Wi-Fi Localization Accuracy\*

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## ABSTRACT

This study investigates the impact of small ground truth (GT) errors on indoor positioning systems based on Wi-Fi fingerprinting. The results demonstrate that even centimeter-scale GT deviations cause severe degradation of measured localization accuracy.

## Keywords

Indoor localization; performance evaluation; small-scale fading; ground truth; fingerprinting; RSS; WLAN.

## 1. INTRODUCTION

Fingerprinting-based indoor positioning systems are often trained and tested in the same reference points [1]. In reality, however, these “same” points can be decimeters apart, depending on the chosen ground truth (GT) methodology [2].

On one hand, minor GT errors seem negligible in comparison to meter-scale Wi-Fi localization errors. On the other hand, small-scale fading of Wi-Fi signals — the result of radio wave interference with its own reflections from surrounding obstacles — causes significant spatial variations of received signal strength (RSS) at sub-wavelength distances ( $\lambda = 12.5$  cm for Wi-Fi). While location tracking systems can detect and mitigate such variations when the user moves [3], this is not possible for non-tracking (single-shot) systems.

In this study we demonstrate that minor GT errors are amplified by small-scale fading and can introduce multi-meter positioning errors, thus affecting benchmarking results of an indoor localization system.

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## 2. PERFORMANCE EVALUATION

To evaluate the impact of imprecise GT, we collected a training Wi-Fi RSS dataset (using a  $3 \times 4$  grid with 2 m step) and several testing datasets, with increasing deviation from the original GT positions. To minimize the impact of non GT related factors, the experiment was conducted in otherwise idealized conditions: same device, same orientation, same hour, minimal human presence. The results show that even centimeter-scale dislocations between the calibration and testing points significantly reduce the localization accuracy (Figure 1).

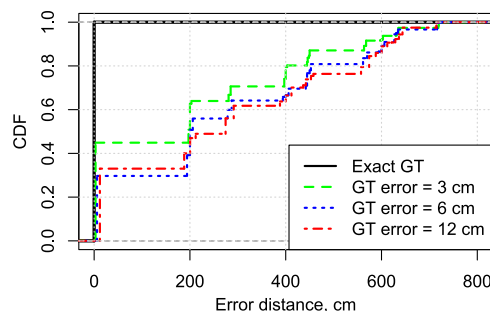


Figure 1: Localization accuracy and GT error.

We thus propose GT quality as a new methodological factor that affects Wi-Fi fingerprinting performance. Curiously, this makes localization accuracy directly dependent on the experimenter’s diligence. Moreover, this partially explains some of the already known accuracy-limiting factors (such as device diversity, different-person evaluation, accuracy degradation with time) as they are also associated with GT errors.

## 3. REFERENCES

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