

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

Andrei Popleteev
SnT, University of Luxembourg
contact@popleteev.com

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.

*This work was supported by the National Research Fund of Luxembourg (C14/IS/8311593).

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

MobiSys'17 June 19-23, 2017, Niagara Falls, NY, USA

© 2017 Copyright held by the owner/author(s).

ACM ISBN 978-1-4503-4928-4/17/06.

DOI: <http://dx.doi.org/10.1145/3081333.3089310>

2. PERFORMANCE EVALUATION

To evaluate the impact of imprecise GT, we collected a training Wi-Fi RSS dataset (using a 3×4 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).

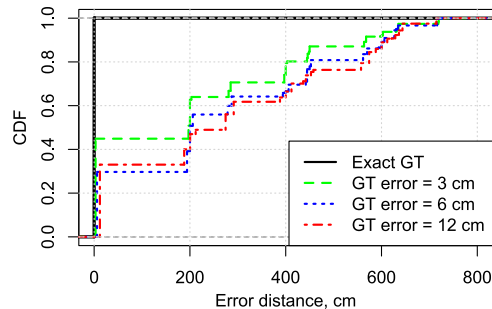


Figure 1: Localization accuracy and GT error.

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

- [1] S. Adler, S. Schmitt, K. Wolter, and M. Kyas. A survey of experimental evaluation in indoor localization research. In *Proc. IPIN-2015*, 2015.
- [2] A. Popleteev. HIPS: Human-based indoor positioning system. In *Proc. IPIN-2016*, 2016.
- [3] M. Youssef and A. Agrawala. Small-scale compensation for WLAN location determination systems. In *Proc. WCNC-2003*, 2003.