

## Introduction

- Tracking of ground targets from power measurements from several antennas is a challenging problem.
- Use of prior information like road maps can increase the accuracy of tracking algorithms significantly.

## Power Measurements

Theoretical model for the received signal strength measurements (in dB):

$$P_R = P_T - 10\alpha \log_{10}(r) + e_k$$

- $P_R, P_T$ : Received and transmitted signal strength in dB.
- $r$ : Radial distance between the target and the transmitter.
- $e_k$ : Noise.

In reality, the noise level is high and  $P_R$  depends on multipath and non-line-of-sight (NLOS) conditions.

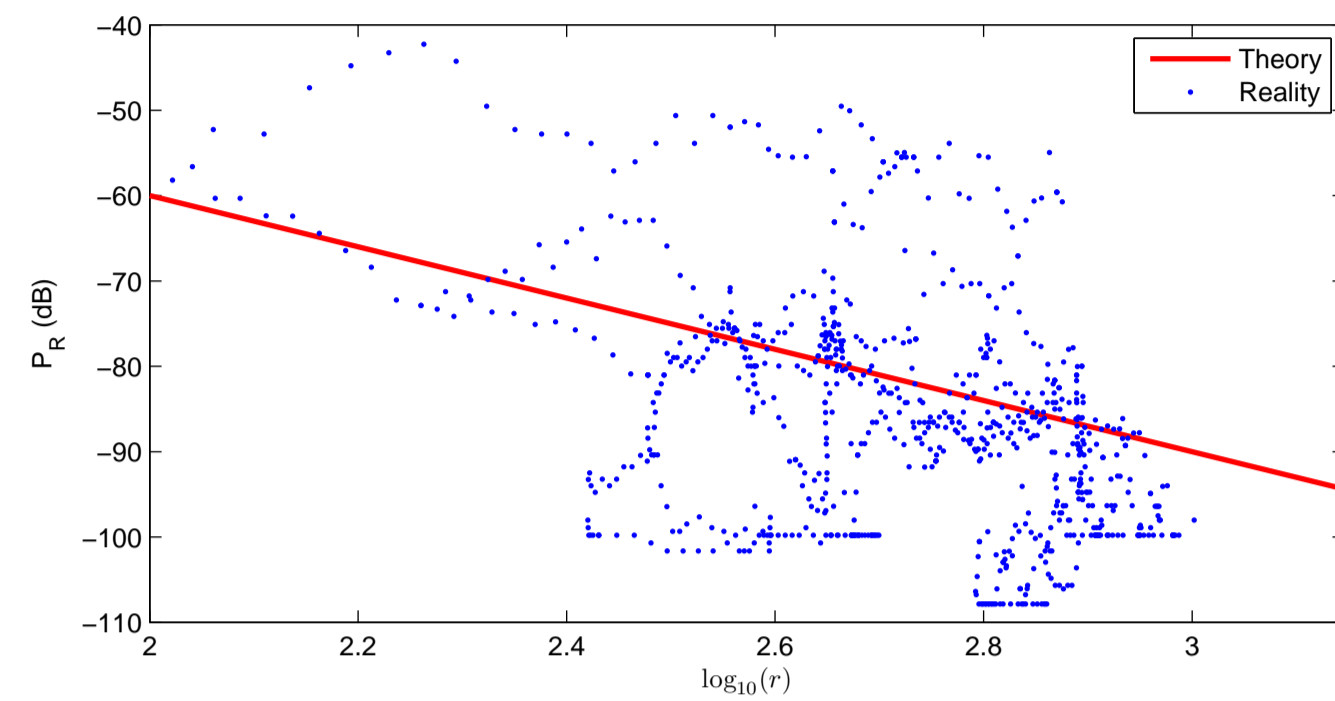


Figure 1: Theory vs. reality for power measurements.

## Fingerprinting

- Extensive data has been collected from an area close to Brussels.
- A map of the collected measurements from each location (called a *fingerprint*) is formed and used as a measurement model.

## Road Map and Antennas

- The road map used is composed of linear segments.
- There are 7 antennas distributed over 3 sites.

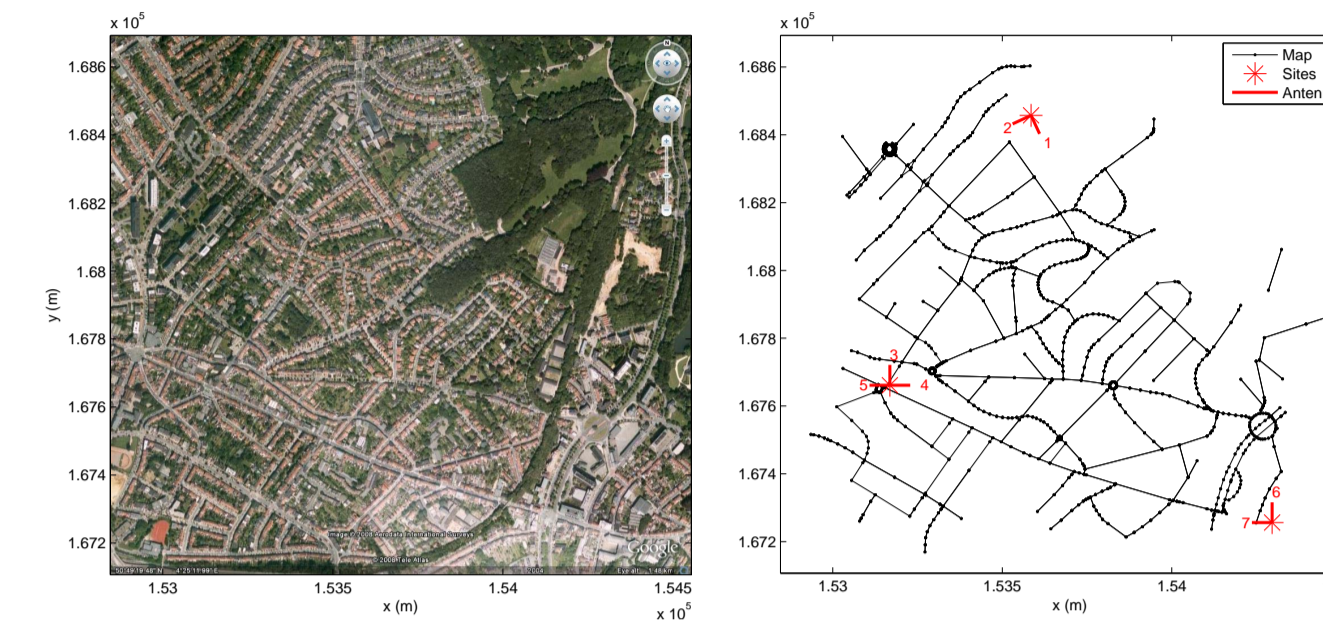


Figure 2: Map of the area under study and the antennas.

## Particle Filters

Two particle filters (PF) are run.

- Off-road PF does not use road map and assumes nearly constant velocity.
- On-road PF uses the road network information and assumes nearly constant velocity on the road.
- Both filters use the previously collected fingerprints as the measurement model.

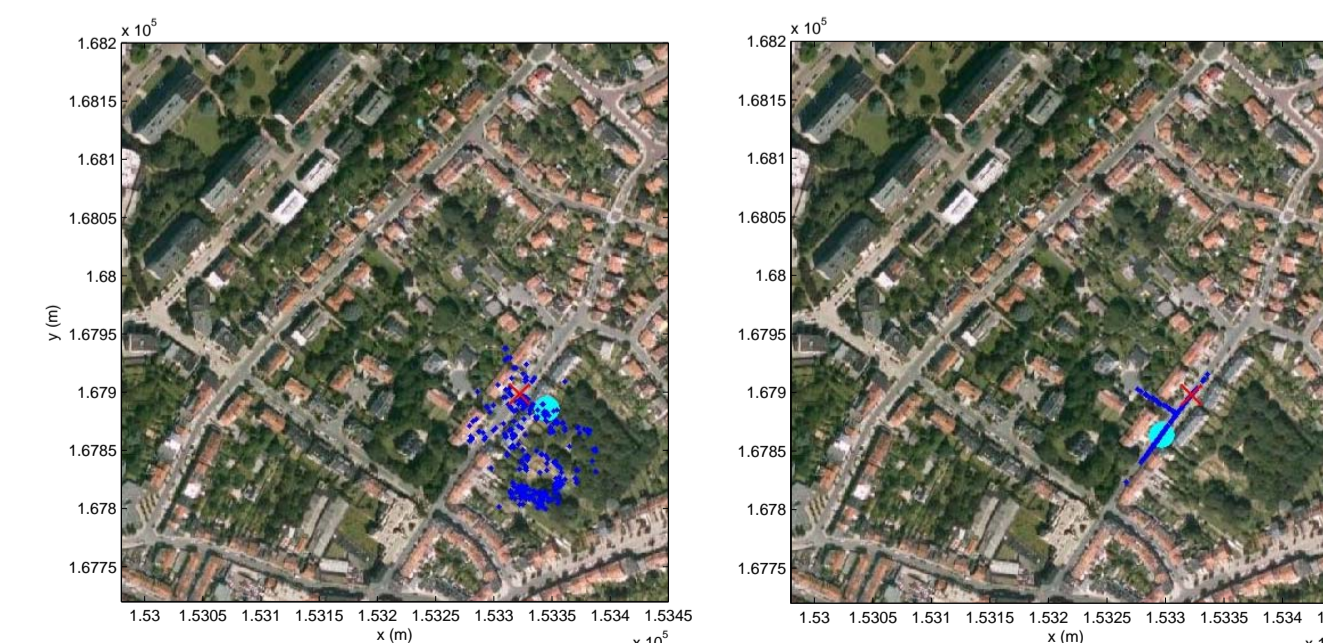


Figure 3: A snapshot from the PF runs.

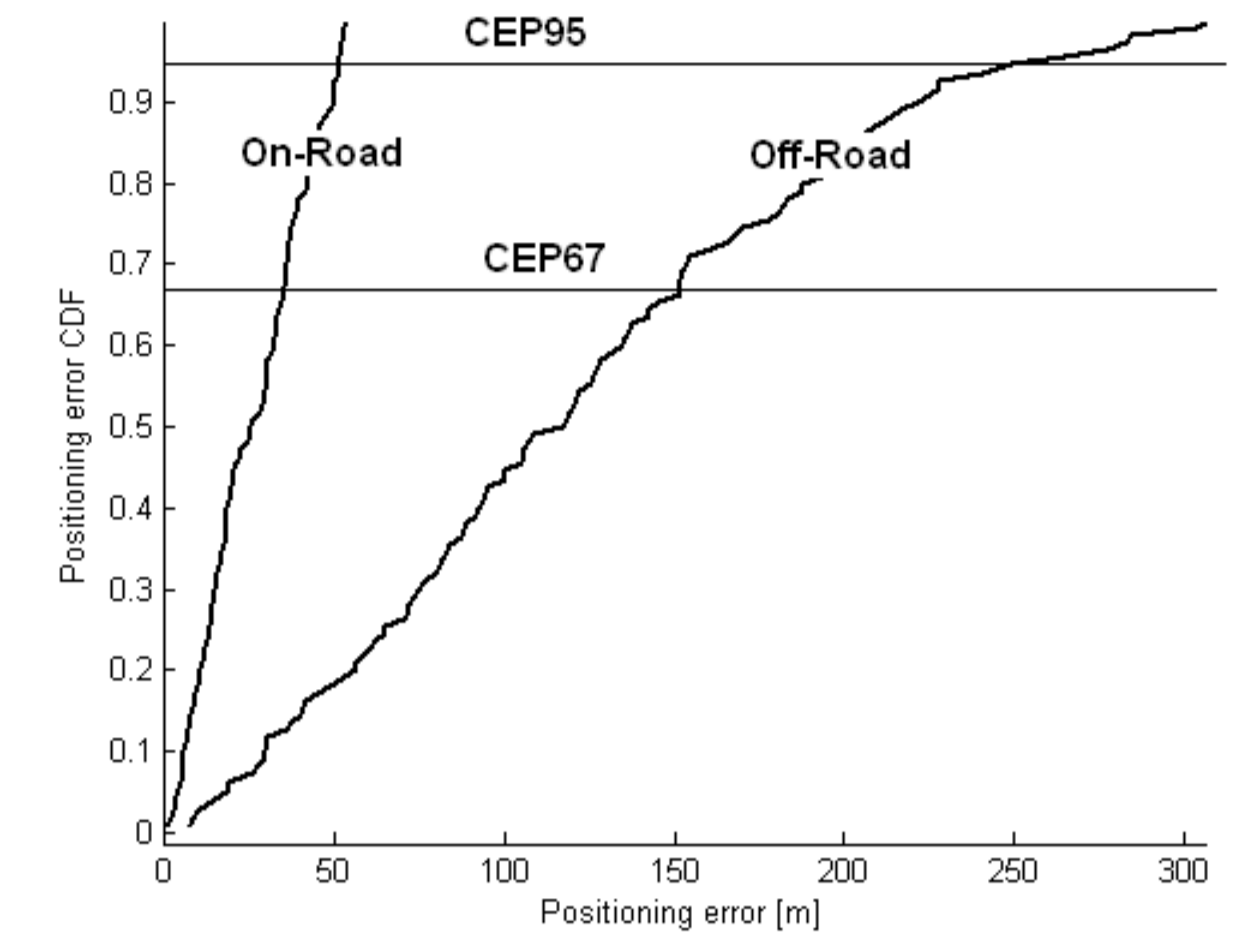


Figure 4: Cumulative distribution functions (CDF) of the PF estimation errors.

## Conclusions

- Fingerprinting can be combined with particle filters.
- Road map information can make the estimation errors even four times smaller.

## References

- [1] M. Bshara, U. Orguner, F. Gustafsson, and L. V. Biesen, "Fingerprinting localization in WiMAX networks based on received signal strength measurements," *Submitted to IEEE Transactions on Vehicular Technology*, 2009.
- [2] —, "Tracking in WiMAX networks depending on SCORE measurements," *Proceedings of the 6th Workshop on Positioning, Navigation and Communication 2009 (WPNC'09)*, Mar. 2009.