WiFi based Indoor Localization

GPS signals do not penetrate into buildings.

- How about bringing GPS like trilateration to WiFi?
- Any challenges / problems?

GPS vs. WiFi

- Mostly line of sight (LOS) with few echoes or multipath.
- Heavy echo or multipath in indoor env.
- WiFi access points / BS / routers are not CLK sync. across diff owners.
- WiFi AP locations are unknown.
- GPS satellites are CLK syn.
- GPS satellite locations are known.
Key idea: 1999 WiFi standard → IEEE 802.11

WiFi RADAR → Localize laptops or PDA in indoor environments.

→ RSSI Fingerprinting.

Received Signal Strength Index

\[
\text{Power} = \frac{1}{K} \sum_{i=1}^{K} |S_i|^2
\]

\[
\text{Energy} = \sum_{i=1}^{K} |S_i|^2
\]

Calibration Fingerprinting

War driving Training

\[
P_1, P_2, P_3 \rightarrow L, \Theta ?
\]

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<th>Loc</th>
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<th>( \text{RSSI}(W_1) )</th>
<th>( \text{RSSI}(W_2) )</th>
<th>( \text{RSSI}(W_3) )</th>
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<td>L1</td>
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1) Nearest neighbor: Pick nearest labeled point and declare the label as the blue user's location.

2) K-Nearest neighbors and compute avg.

Can you find a scenario in which K-NN performs worse than NN?
Avg. location error over all test cases

100 red test cases out of 500 red measurements

Use $k^*$ for new blue test case

WiFi localization $\rightarrow$ 2m - 10m

avg 5m