

Reducing the Localization Error in Wireless Sensor Networks by Considering the Measurements Spatial Relationship



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Basics: Resource Aware Localization

- Multiple trilaterations to available beacons*
- Leads to c possible positions depending on distances

$$c = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

$r=3$ (for trilateration in 2D); n : number of beacons

* beacons know their own position by a preinstalled localization system

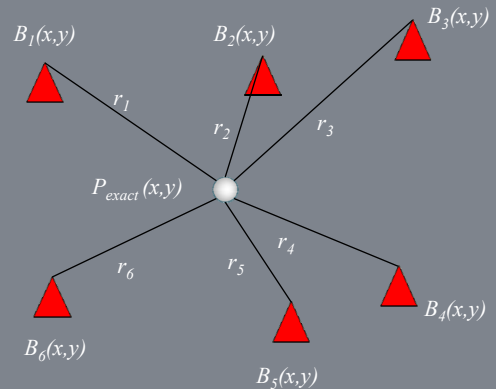


Fig. 1: Lateralation with multiple beacons and one unknown

Problem: Communication Channel Errors

- Distance estimations can be highly defective
- Measurements like Signal Strength are affected by:
 - Multipath propagation
 - Fading etc.
- Issue: Find positions that are not influenced by distance errors and thus are more precise.

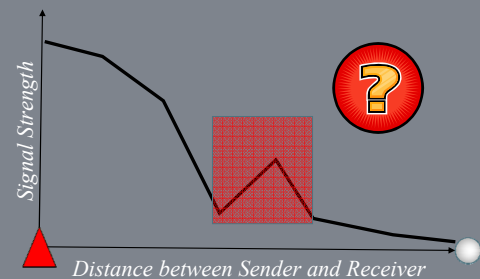


Fig. 2: Signal strength outlier over distances

Solution: Use Sensor Constraints to Filter improbable Positions

- Sensor values can be related with the geography
- Simple example (see Fig. 3): laboratory floor
 - Access points (beacons) are placed in an infrastructure
 - Sensors are plugged at a mobile tray and measure temperature and humidity continuously
 - Mobile tray must be located at every time by measuring the Received Signal Strength (RSSI)
 - Walls, objects and people influence the RSSI
 - Thus 10 different positions are estimated by trilateration

- Approach:
 - Sensor intervals or reference values can be defined for every room
 - Wrong positions (red) are filtered by simple logical tests, probable positions (green) remain

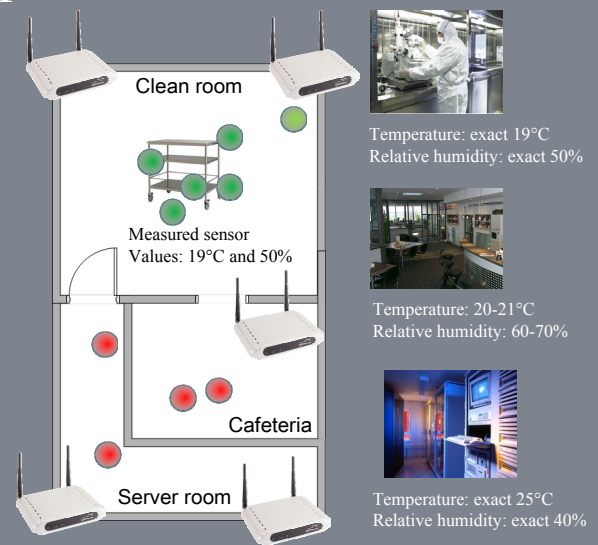


Fig. 3: Exemplary top view on a laboratory floor