UNIVERSITÄT BERN

Distributed Event Detection and Localization Architecture for Wireless Sensor Networks

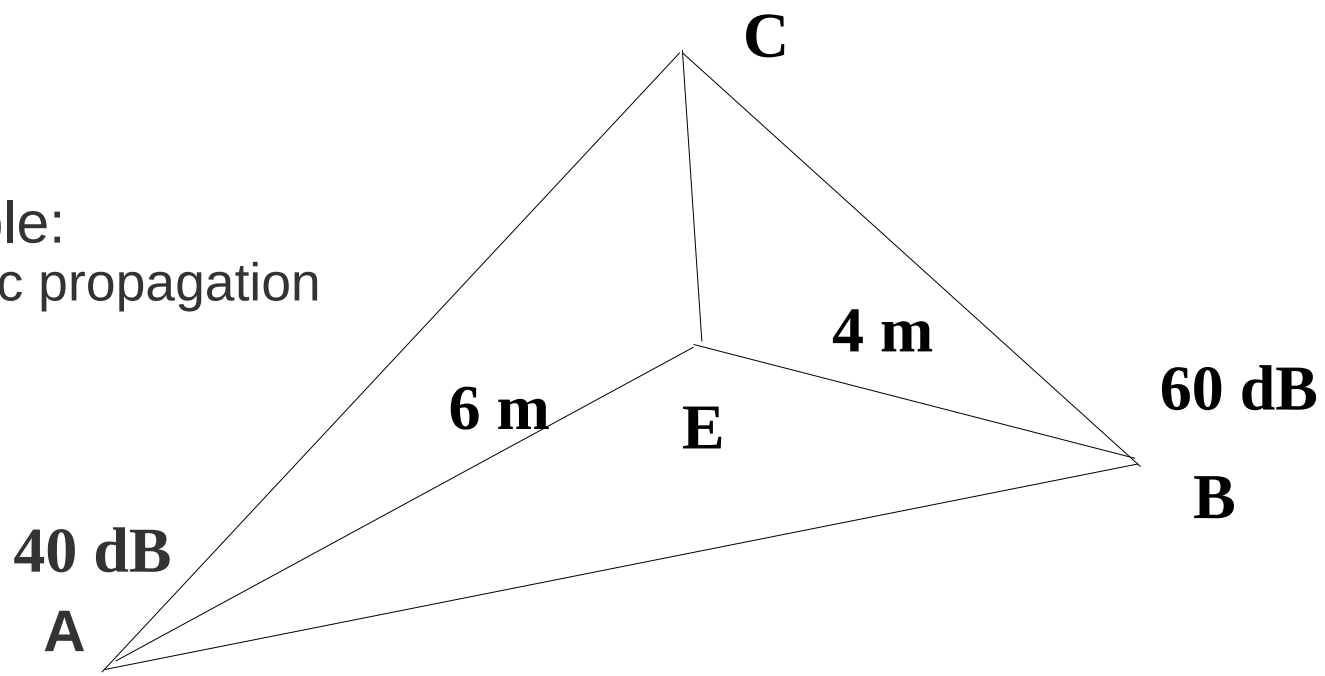
Markus Waelchli
University of Bern

Overview

- MICS Cluster 4
  - In-network information management
- Event localization
  - Multilateration
  - Intensity-based
  - Challenges / Outlook
- Other projects

Multilateration

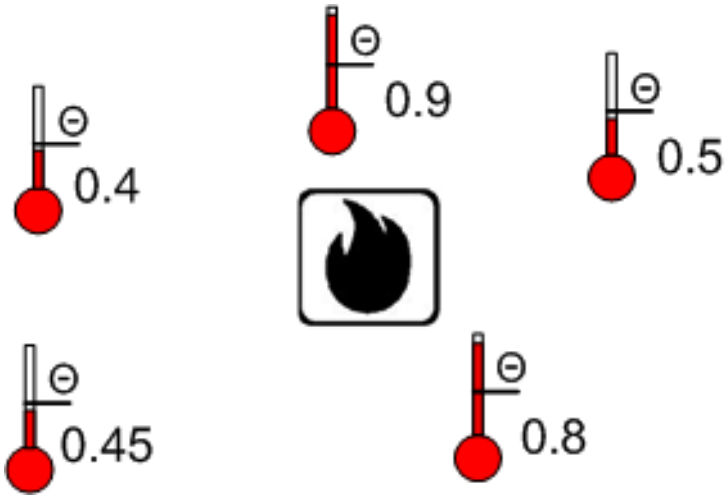
- Nodes know their position
- Distance estimations between nodes and event are needed
- Example:
  Acoustic propagation



- We use the ratio of the measurements instead of distance estimations

Intensity

- Value indicating the intensity of an event can be derived at each sensor node sensing the event
- Intensity may be computed from multiple measurements
- Intensity depends on the sensor location



Intensity-based Localization (ILA) I

- Nodes know their position
- Signal attenuation model
  - Intensity (ω) is related to the distance (d) between a sensor A and the event E

$$\omega \sim \frac{1}{d^{\alpha}} \quad , \alpha > 1 \qquad (1)$$

- Distance between A and E can be calculated with the theorem of Pythagoras

$$d^2 = (a_x - e_x)^2 + (a_y - e_y)^2 \qquad (2)$$

Intensity-based Localization (ILA) II

- Gluing (1) and (2) together we derive the general equation to get the ratios of the intensities of two sensor nodes A and B:

$$\frac{(a_x - e_x)^2 + (a_y - e_y)^2}{(b_x - e_x)^2 + (b_y - e_y)^2} = \left(\frac{\omega_B}{\omega_A}\right)^{\frac{2}{\alpha}} \qquad (3)$$

- Assuming n collinear nodes (n>3)
  - We get a system with n-1 quadratic equations
  - The system can be linearized

Challenges / Outlook

- Implementation of ILA in Simulator (OMNeT++)
- Investigating sound measurement error models
- Comparison to other event localization schemes

- Distributed winner election

- Object tracking
- Adapting to multiple concurrent event sources
- Distributed detection of outliers / obstacles
- Sensor field monitoring / learning

Other projects

- Energy efficiency
  - Energy efficient MAC
  - Coordinated sleeping
- Evaluating event detection in small real world scenarios