EE4C03 Assignment: Indoor localization

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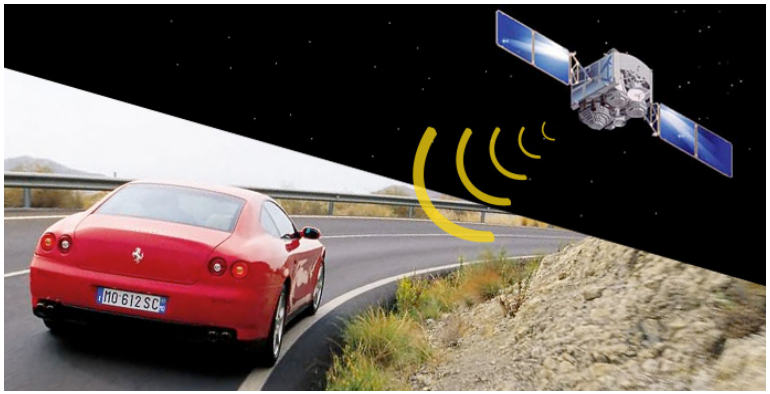
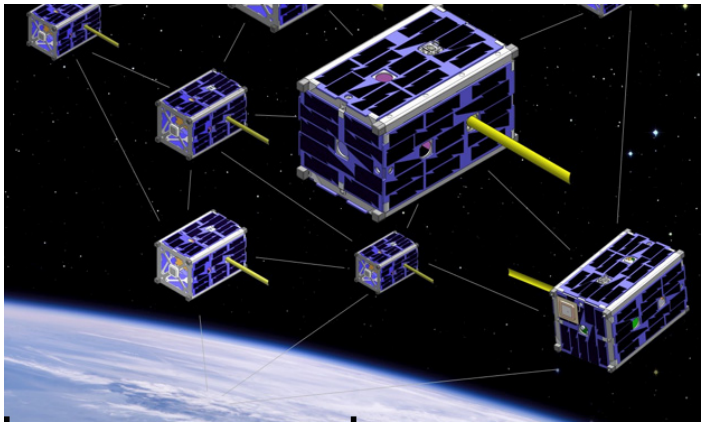
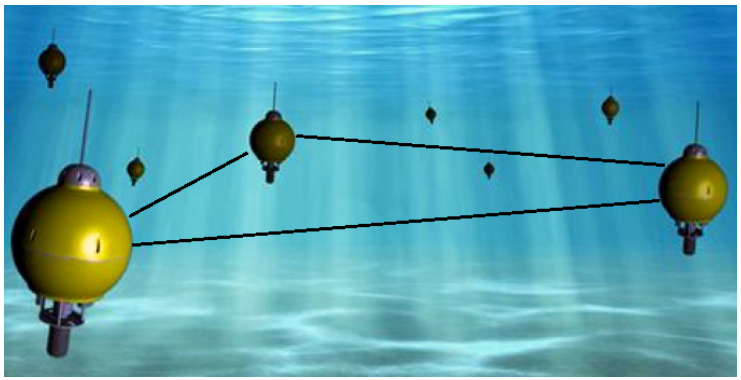
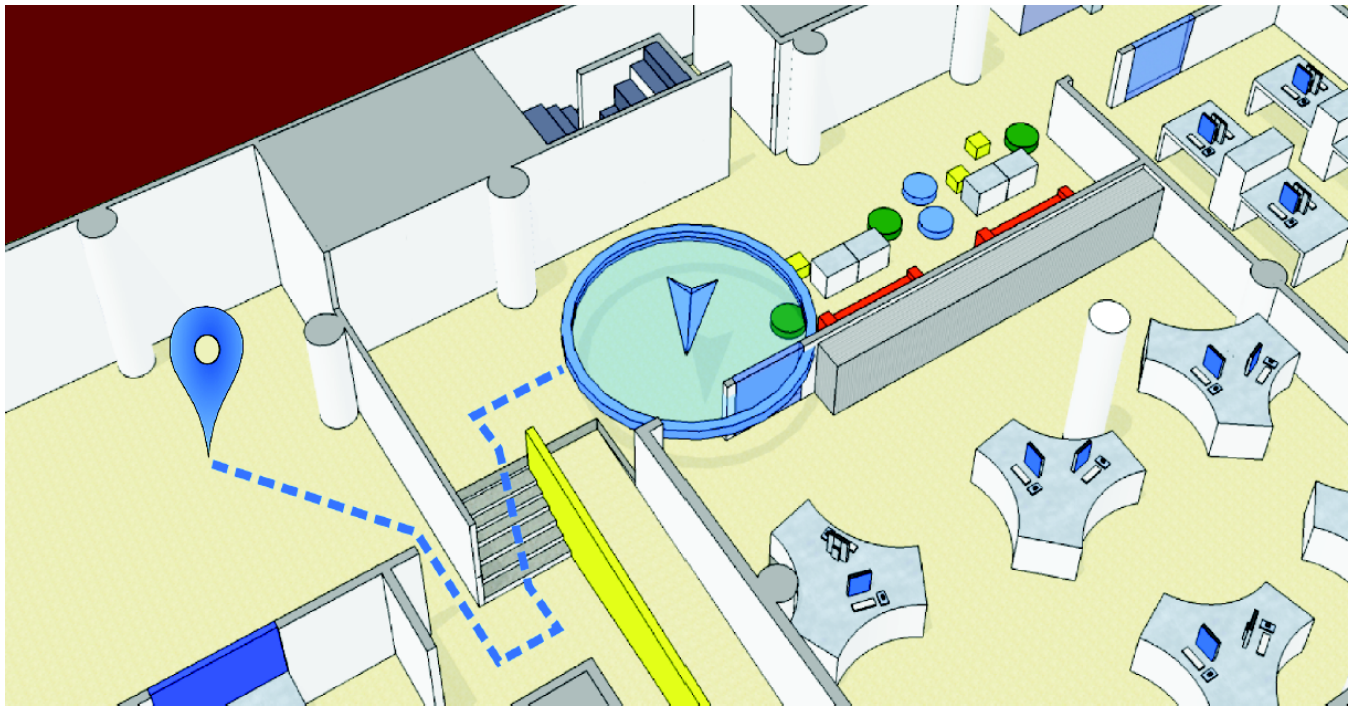
Motivation







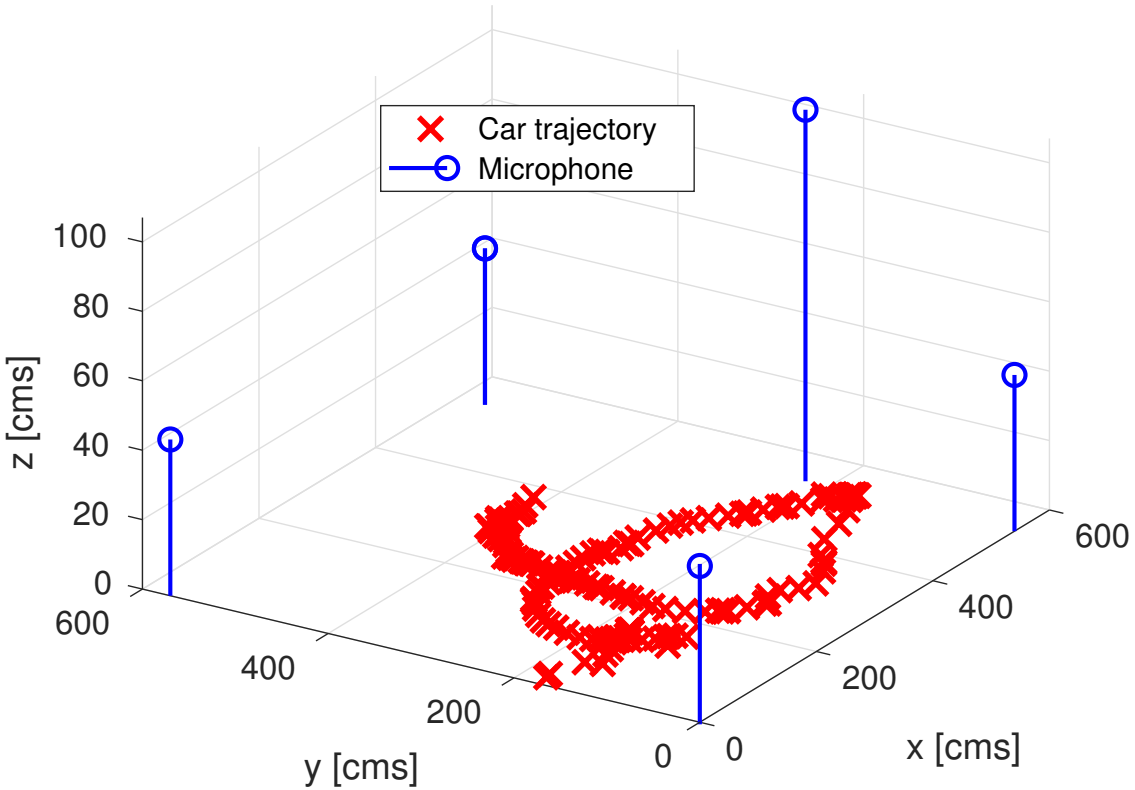
Indoor Localization



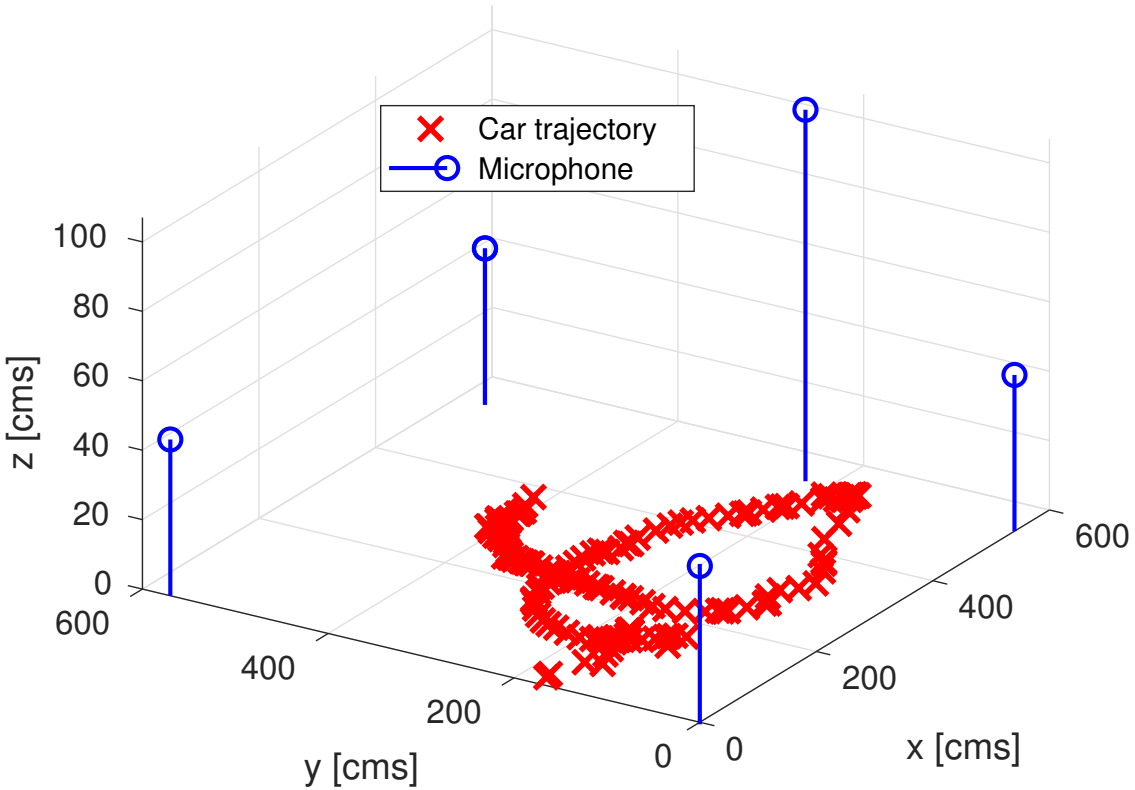
Applications

- Guiding customers in shopping malls, museums, etc.
- Track and trace of objects in warehouses and factories
- Path-finding for mobile indoor robots (video)

Experiment


Car trajectory
Microphone
z [cms]
100
80
60
40
20
0
600
400
200
0
y [cms]
0
200
400
600
x [cms]

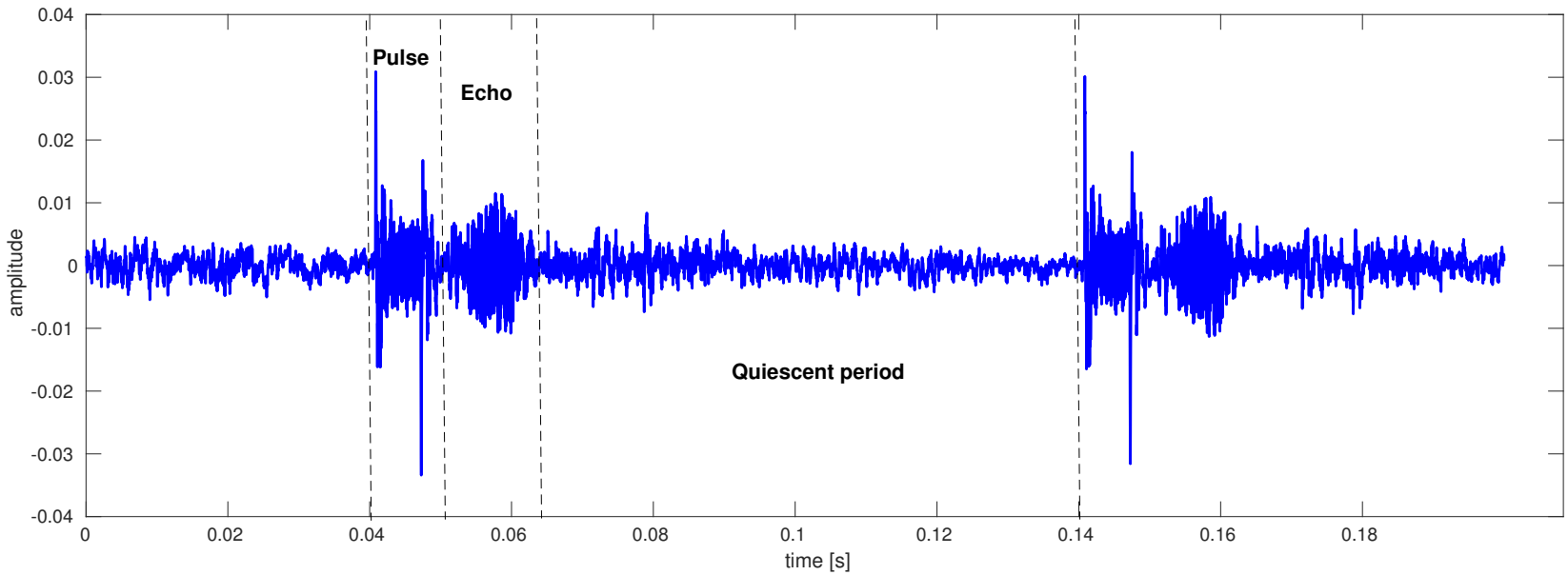
Experiment



Measurements

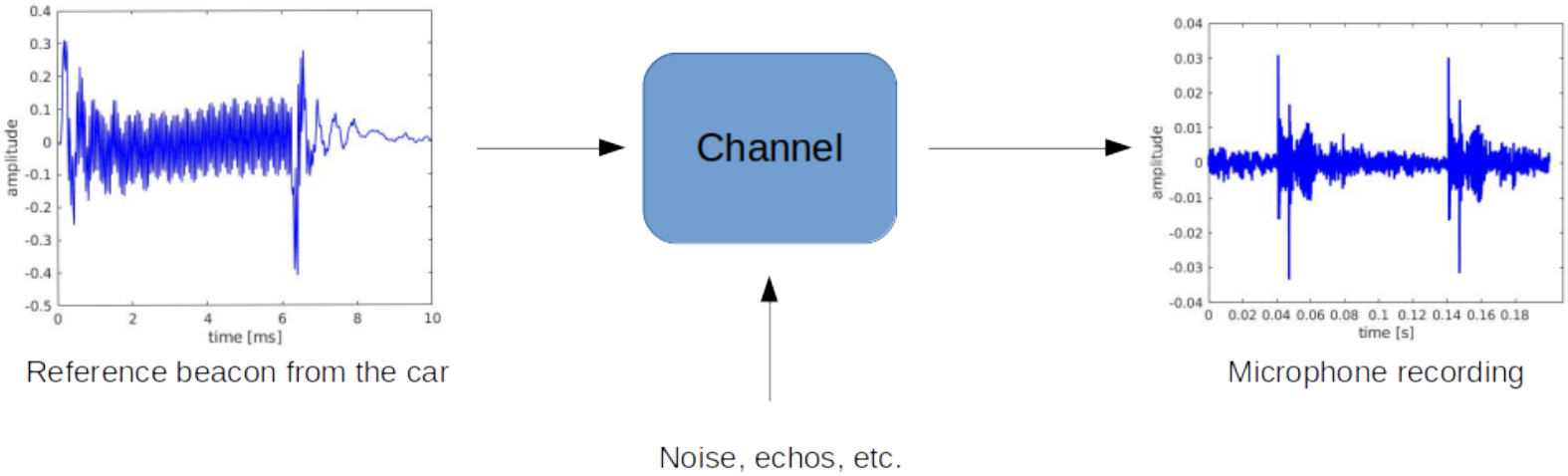
- Reference beacon emitted from the car
- Microphone recordings for each location in the trajectory

Microphone output



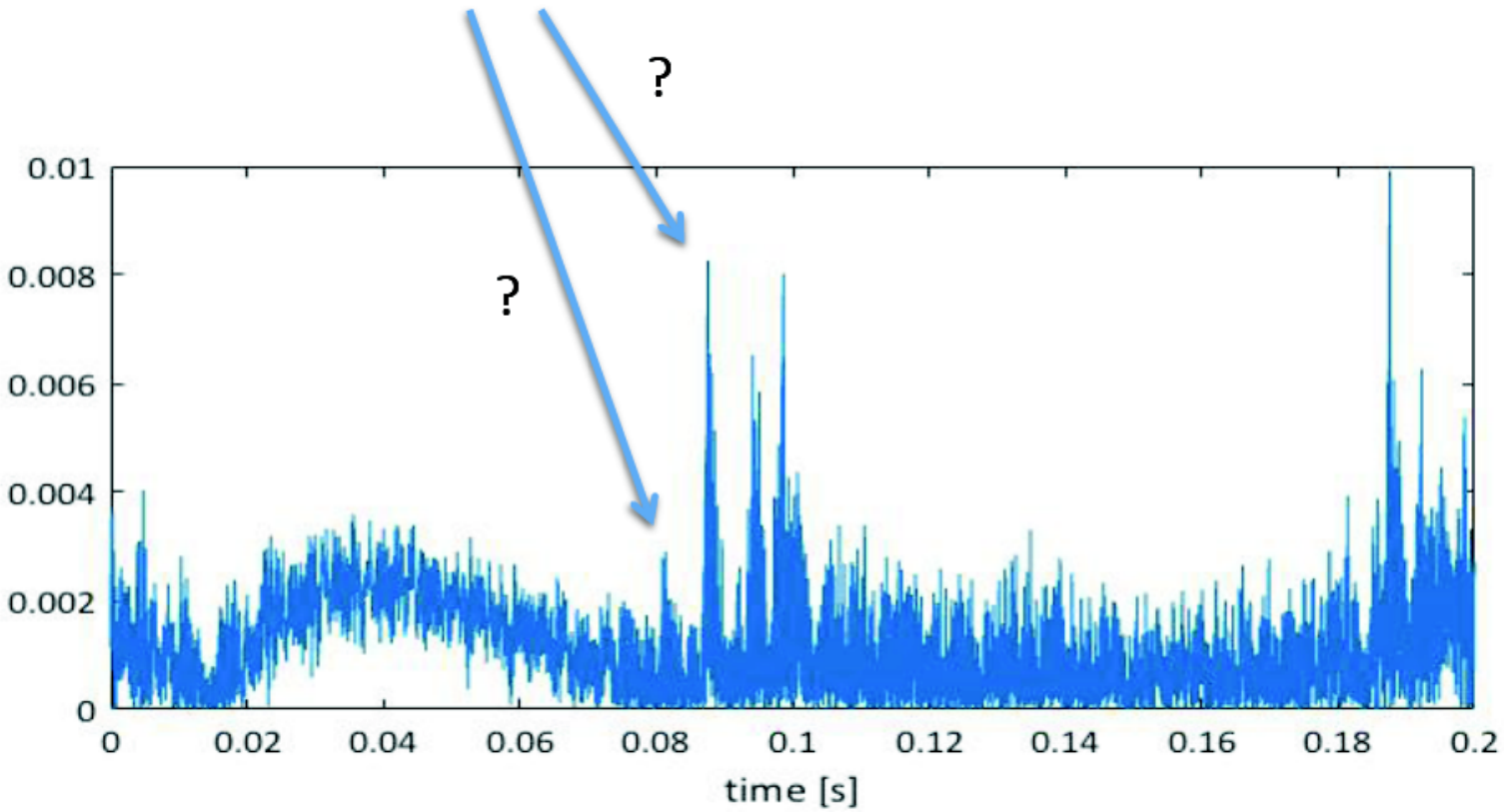
How to identify the time of flight from microphone recordings?

Step 1: Filter design



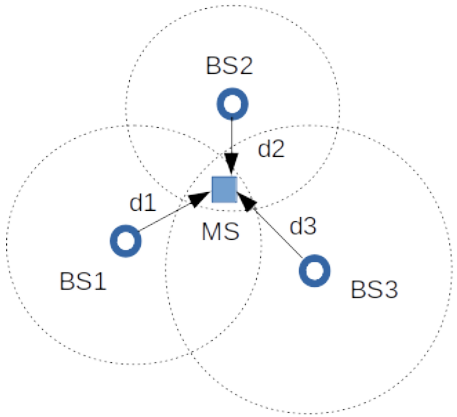
- Deconvolve the reference beacon from microphone recordings.
- How to design an optimal filter ? See:
  - Chapter 7,9 Hayes: Optimum and Adaptive filtering
  - Ch.4a lecture slides: Example application on channel estimation

Step 2: Time of flight

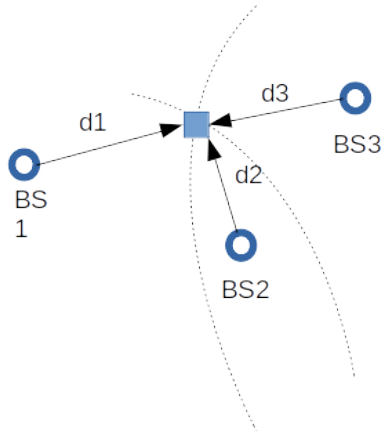


- Processed time series shows multiple time of flights
- How to robustly estimate time of flight ?

Step 3: Network localization



Time of Arrival
(ToA)



Time Difference of Arrival
(TDoA)

- BS: Base station with known positions,
- MS: Mobile station whose position is to be estimated
- Distances are measured from time of flight between BS and MS

Assignment

Tasks:

- Design an optimum filter to estimate the time of flights
- Estimate car locations, using distance estimates using ToA/TDoA
- Write an essay of 4-10 pages, with MATLAB codes in the appendix
- Motivate the use of the chosen techniques
- How accurate is your localization algorithm ?

Pointers:

- How to robustly reject outliers ? Use sptial constraints of the room
- Can we predict the location of car using the measurement history ?
- Use only the theory from EE4C03

References

- Ch. 7,9, M.H.Hayes, Statistical digital signal processing and modeling,
- P. Stoica and J. Li, "Lecture notes-source localization from range-difference measurements," IEEE Signal Processing Magazine (2006).
- A.H.Sayed, A.Tarighat, and N.Khajehnouri. "Network-based wireless location: challenges faced in developing techniques for accurate wireless location information." IEEE Signal Processing Magazine (2005).

Suggestion: Perform a brief literature survey on localization.