Sensorfusion TSRT14

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AUTOMATIC CONTROL
REGLERTEKNIK
LINKÖPINGS UNIVERSITET

Introduction

Sensor fusion deals with extracting information from spatially distributed sensors, which may be of different modality. The mathematic methodology in this course comes mainly from statistical estimation and nonlinear filtering theory. A common application theme is localization, either of one's own platform (the navigation problem) or of other moving objects (the tracking problem).

The industrial need for engineers with a sensor fusion expertize is reflected in the fact that more than 10 master theses are performed in this area each year. The course is to a large extent influenced by over 100 theses in sensor fusion!

The course covers the whole range from the mathematical fundamentals to state of the art applications. Laborations are central in the course.

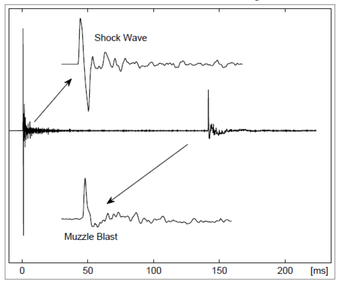
Selected content of the course

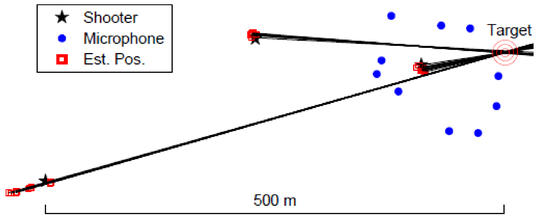
- Detection, localization and tracking in sensor networks using observations from camera, microphone, geophone, radar, laser, radio *etc*.
- Nonlinear filtering. Kalman filtering for linear systems is extended to EKF/UKF and the modern particle filter.
- Simultaneous localization and mapping (SLAM).
- Common motion and sensor models.

Master thesis work

The number of yearly master theses is between 10 and 15. One such work is illustrated below:

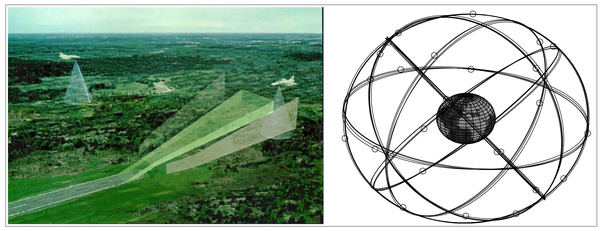
Localization of sniper. A wireless network of microphones is deployed to increase safety around important infrastructure, and one of the tasks is to detect and localize snipers. The figure illustrates how first the shock wave and then the muzzle blast reach one microphone. These two events can be detected and used in a sensor fusion framework. The thesis investigated how well the sniper can be localized and the shooting angle estimated using data from field trials, where different ammunition and weapons were tested.





Applications in the course

- Navigation with GPS.
- Tracking of aircraft from radar.

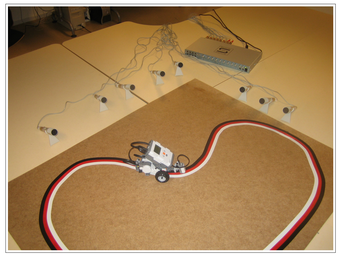


- Surveillance in sensor networks.
- State estimation in vehicles.
- Pose estimation in film cameras.

Laborations

Laboration 1: localization of vehicles

A vehicle (Lego Mindstorm robot) is moving autonomously over the terrain. A network of microphones is detecting characteristic sounds (sine pulses). The task is design the network, calibrate the sensor locations off-line and to localize and track the vehicle on-line.



Laboration 2: Simultananeous localization and mapping

An autonomous vehicle is exploring unknown terrain. The on-board sensor (microphone) detects characteristic landmarks (speakers emitting tone pulses). The task is to map the landmarks on the fly, while at the same time navigating relative to this map.

Basic facts

- Eligible course for Y, D, IT and I.
- Spring period 2.
- Course started in 2008 with 20 participants.
- 10 lectures, 8 lessons and 2 laborations.
- 6hp.
- Examination: Computer examination and 2 laboration reports.
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