ACS6124 Multisensor and Decision Systems
Part I – Multisensor Systems
Lab A: Sensor Signal Estimation

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Aims

- To relate theory and practice of sensor signal estimation and detection in engineering applications.

- To demonstrate the understanding of different design considerations depending on e.g. the availability of prior knowledge.

Objectives

At the end of the lab, you will be able to

- Implement sensor signal estimation schemes based on measurement data and different prior knowledge.

- Design algorithms that improve the estimation as new measurements arrive.

How to use MATLAB files

Download the files from ACS6124 Course Content at Blackboard at Labs/ACS6124 Part I - Multisensor Systems - Laboratory/LabAFiles.zip. Extract and put those files in your working directory and add the corresponding working path to MATLAB.

Sensor Signal Estimation

Imagine you are employed in a wind turbine manufacturing company and have been tasked to design a multisensor signal estimation algorithm for the blade pitching mechanism of the wind turbine. In order to measure the pitch angle $\hat{\omega}$, the blade is equipped with a rotary encoder connected to the blade bearing, where the sensor noise is $\nu \sim N(0, 9)$.

Task 1: MMSE estimator

Task 1.1: Write a Matlab script to calculate the MMSE estimator, when the prior knowledge of the angle is uniformly distributed in the range $0° \leq \hat{\omega} \leq 30°$. Consider the scenarios where:

- The entire measurement vector `encoder.mat` is provided. You can find the measurement file inside the module's Assignment folder in Blackboard.

- Only the five first elements of the provided measurement vector are available.

Task 1.2: Extend the script and calculate the MMSE estimator in the case when the prior knowledge is Gaussian distributed with a mean value of 15 and variance of 4. As before, consider both scenarios on the availability of measurements and use the same measurement vector `encoder.mat`.

Task 2: Sequential MMSE estimator

Extend the script and use the appropriate estimator in the case when the prior knowledge is Gaussian distributed with a mean value of 15 and variance of 4 and the measurements arrive in a sequential manner. As before, consider both scenarios on the availability of measurements and use the same measurement vector `encoder.mat`.