Computational Methods for Detection, Estimation and Identification

ASSIGNMENT 1

DEEC
University of Coimbra

2022/2023

Experimental Work

Assume a robotic platform equipped with a sonar system that measures the distance to a wall. The goal of our experiment is to evaluate the performance of the vehicle's breaking system. The robot starts moving toward the wall with a constant velocity v_0. The break is actuated at a distance d_0 from the wall, in order to induce a constant acceleration a_0. The sonar measures the decreasing distance with a frequency of 10 Hz. The readings are collected during 10 seconds and stacked in a data vector $\mathbf{d}$ with dimension 100×1.

Figure 1 plots the first three reading vectors of the first experiment.

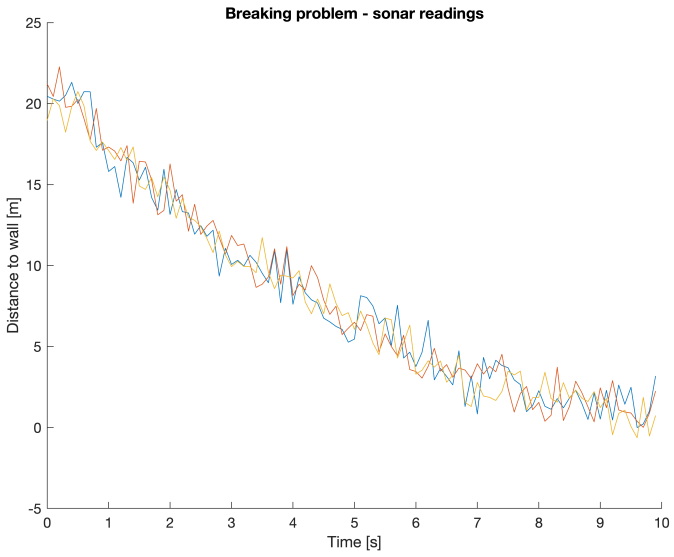

Figure 1: First three readings of the first experiment.

1. File *test1.mat* is a 100×50 matrix with the readings of the first experiment. The same test, with roughly constant motion parameters, is repeated 50 times. Each column of the matrix is a data vector $\mathbf{d}$ with the 100 readings. The noise affecting the readings is independent and follows a standard normal distribution.

   (a) For each run of the experiment, estimate the motion parameters and perform the corresponding p-test.

   (b) Show that the experimental values for the p-test follow a uniform distribution.

   (c) Compute the theoretical value of the confidence interval for each parameter.

   (d) Verify if the derived intervals match the experimental results.

Write a **small report** (maximum 4 pages) of the assignment and submit it, with the **code scripts**, in the system until the deadline defined in the system. The report should show the theoretical derivations and provide explanations to the computed values and the comparisons made.