

# Computational Methods for Detection, Estimation and Identification

## ASSIGNMENT 2

MsC in Electrical and Computer Engineering  
DEEC - University of Coimbra

2022/2023

### Experimental Work

As in the assignment 1, 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 braking system. The robot starts moving toward the wall with a constant velocity  $v_0$ . The brake 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  $100 \times 1$ .

1. The sonar readings for the second experiment are stored in file *test2.mat*. In this case we used an old sonar with over-heating problems. As time goes by the device warms up and the measuring accuracy decreases. For the purpose of the experiment it can be assumed that the noise standard deviation for the  $i^{th}$  reading is  $\sigma_i = i \cdot \sigma$  where  $\sigma$  is a constant.
  - (a) Load the  $100 \times 1$  vector  $\mathbf{d}$  and plot the readings in order to observe the increasing effect of noise.
  - (b) Determine the motion parameters using the estimator derived in the previous section. Does the residue follow a normal distribution? Justify.
  - (c) Obtain the maximum likelihood estimation. Show that in this case the residue follows a normal distribution.
  - (d) Can you check the previous estimation results using p-test? Justify
  - (e) Compute the confidence intervals for the estimation of question c).

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.