INFO8006 Introduction to Artificial Intelligence

Kalman Filter

Learning outcomes

At the end of this exercise session you should be able to:

- Define what is a Kalman filter and be able to use it in the context of a dynamic random process.

Exercise 1: Hyperloop

This year ULiège has decided to get into the Hyperloop competition (`https://www.spacex.com/hyperloop`). Briefly, what you should do to win this competition is to build the fastest and most reliable autonomous pod. One of the most important engineering problem to build the pod is to be able to compute a robust estimation of the state of the pod (its position and speed) given many noisy sensors.

This morning you received an email asking you what would be your solution to this estimation problem. The message contains information about the sensors they plan to put in the pod. They say that they will use 3 unbiased speed sensors with a 99.7% accuracy[1] of 0.1m/s and a GPS sensor (also unbiased) which provides the pod position (in one dimension) with a 99.7% precision of 1 meter. After some research on the web you find out that you should use a Kalman filter to solve this task.

Define the components of your Kalman filter in the context of the state estimation of the pod. You can assume that the acceleration a is distributed normally around $\mu_a m/s^2$ with a variance equal to σ_a^2.

[1] It means that 99.7% of the value measured will get a smaller error. e.g. (`https://math.stackexchange.com/questions/1412683/3-sigma-approximation`)