Examen localisation, ENSTA-Bretagne, ENSI 2.

Le 31 mars. A faire sur l'ordinateur.

Tous documents autorisés. Durée: 1h15.

Exercise 1. We consider a boat the motion of which is described by the discretized state equation:

$$\begin{cases} x_1(k+1) &= x_1(k) + x_2(k) \cdot u(k) \\ x_2(k+1) &= x_2(k) + \alpha_2(k). \end{cases}$$

We measure the input $u(k)$. At the initial moment, we know that x_1 is zero and that x_2 is close to 1. $x_2(0)$ will be represented by a Gaussian distribution whose mean is equal to 1 and whose standard deviation is 0.02. The scale factor x_2 evolves slowly by means of $\alpha_2(k)$ that we will assume to be centered, white and of standard deviation 0.01.

1) We apply an input $u(k) = 1$ for $k = 0, \ldots, 9$ and $u(k) = -1$ for $k = 10, \ldots, 19$. Write a MATLAB program that implements a predictive Kalman filter capable of estimating $x_1(k)$.

2) Draw the confidence ellipses associated with the probability $\eta = 0.99$. How does the uncertainty evolve for x_1 in function of k ?

3) In function of k, draw the determinant of the covariance matrix $\mathbf{\Gamma_x}$. Discuss.

You should send by email a pdf file containing all figures, the explanations and the Matlab code to lucjaulin@gmail.com.
