Examen localisation, ENSTA-Bretagne, ENSI 2.

Le jeudi 5 mars 2020. Appareils électroniques interdits.
Polycopié et notes manuscrites interdits
Durée: 60 minutes.

We consider the Dubins car is described by the state equations:

$$\left\{ \begin{array}{rcl} \dot{x} & = & \cos\theta \\ \dot{y} & = & \sin\theta \\ \dot{\theta} & = & 1+\sin t \end{array} \right.$$

θ is the robot's heading and (x, y) the coordinates of its center. The environment is composed with two landmarks

$$\mathbf{a} = \begin{pmatrix} 0 \\ 2 \end{pmatrix}, \ \mathbf{b} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}.$$

At each step, the robot is able to measure the distance to $\mathbf{a}$ with an accuracy of $\pm 0.1m$ and the bearing to $\mathbf{b}$ with an accuracy of ± 0.1rad. The robot does not know its initial position but measures its heading θ with a very good accuracy.

Propose a Kalman filter to estimate the position x, y of the robot. You should explain what you take for the inputs of the Kalman filter: $\mathbf{A}_k, \mathbf{B}_k, \mathbf{C}_k, \mathbf{y}_k$ and for the covariance matrices, in order to be consistent with the exercise. Give also the dimension of these quantities. The equations of the Kalman filter are depicted in the following figure.