Kalman
Exos

Exercice 13 : Murs

1) $d^i = \det \begin{pmatrix} u_1^i & x_1 - a_1^i \\ u_2^i & x_2 - a_2^i \end{pmatrix} + \beta_i$

$\Leftrightarrow \quad d = u_1^i (x_2 - a_2^i) - u_2^i (x_1 - a_1^i) + \beta_i$

$\Leftrightarrow \quad d^i + u_1^i a_2^i - u_2^i a_1^i = -u_2^i x_1 + u_1^i x_2 + \beta_i$

$\Leftrightarrow \quad d^i - \bar{d}^i = \begin{pmatrix} -u_2^i & u_1^i \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \beta_i$

avec $\bar{d}^i = u_2^i a_1^i - u_1^i a_2^i$

$y = \begin{pmatrix} d^1 - \bar{d}^1 \\ d^2 - \bar{d}^2 \\ d_3 - \bar{d}^3 \end{pmatrix} \quad C = \begin{pmatrix} -u_2^1 & u_1^1 \\ -u_2^2 & u_1^2 \\ -u_2^3 & u_2^3 \end{pmatrix} \quad y = Cx + \beta$

Exercice 18 : Deadreckoning

2) On pose $z = \begin{pmatrix} x \\ y \\ v \end{pmatrix}$, $\dot{z} = Az + u + \alpha$

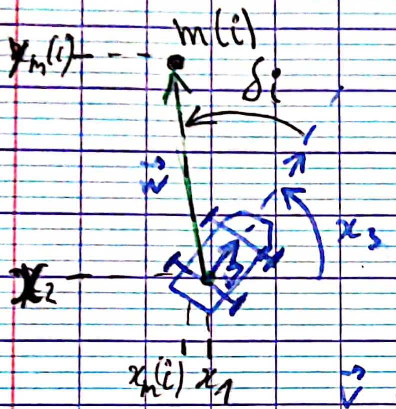
avec $A = \begin{pmatrix} 0 & 0 & \cos\delta \cos\theta \\ 0 & 0 & \cos\delta \sin\theta \\ 0 & 0 & 0 \end{pmatrix}$, $u = \begin{pmatrix} 0 \\ 0 \\ u_1 \end{pmatrix}$ et $\alpha = \begin{pmatrix} 0 \\ 0 \\ \alpha_1 \end{pmatrix}$

$z_{k+1} = \underbrace{(I + dt A)}_{A_k} z_k + dt * (u + \alpha) = A_k z_k + u_k + \alpha_k$

Exercice 19 : Goniométrique

1) $$\dot{z} = \begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_4 \end{pmatrix} = \underbrace{\begin{pmatrix} 0 & 0 & \cos x_5 \cos x_3 \\ 0 & 0 & \cos x_5 \sin x_3 \\ 0 & 0 & 0 \end{pmatrix}}_{A_k} \begin{pmatrix} x_1 \\ x_2 \\ x_4 \end{pmatrix} + \underbrace{\begin{pmatrix} 0 \\ 0 \\ u_1 \end{pmatrix}}_{u} (+\alpha)$$

L'équation d'évolution est linéaire.



$$\vec{v} = \begin{pmatrix} \cos(x_3 + \delta_i) \\ \sin(x_3 + \delta_i) \end{pmatrix}$$

$$\vec{w} = \begin{pmatrix} x_m(i) - x_1 \\ y_m(i) - x_2 \end{pmatrix}$$

$\vec{v}$ et $\vec{w}$ sont colinéaires donc :

$$\det(\vec{v}, \vec{w}) = 0 \iff \cos(x_3 + \delta_i)(y_m(i) - x_2) = \sin(x_3 + \delta_i)(x_m(i) - x_1)$$

$$\iff \underbrace{-x_m(i)\sin(x_3 + \delta_i) + \cos(x_3 + \delta_i)\, y_m(i)}_{y_i} = \begin{pmatrix} -\sin(x_3+\delta_i) & \cos(x_3+\delta_i) \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \beta_i$$

$$y_i = \begin{pmatrix} -\sin(x_3 + \delta_i) & \cos(x_3 + \delta_i) & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_4 \end{pmatrix} + \beta_i$$

$$y(k) = \begin{pmatrix} 0 & 0 & 1 \\ -\sin(x_3 + \delta_1) & \cos(x_3 + \delta_1) & 0 \\ \vdots & \vdots & \vdots \\ -\sin(x_3 + \delta_i) & \cos(x_3 + \delta_i) & 0 \end{pmatrix} z(k) + \beta(k)$$

On a l'équation d'observation associée.

2) $z(k+1) = z(k) + dt\, \dot{z}(k) = (I + dt A_k) z(k) + dt\, u + \alpha(k)$

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