(1)

Simulation

(Q1) $\overrightarrow{BA} = \overrightarrow{BO} + \overrightarrow{OA}$

$\Rightarrow \lambda \overrightarrow{x_3} = L \overrightarrow{x_0} + h \overrightarrow{z_1}$

$$\left| \begin{array}{ll} \overrightarrow{x_3} = \cancel{\sin\beta} \cos\beta \overrightarrow{x_0} - \sin\beta \overrightarrow{z_0} & (\times \lambda) \\ \overrightarrow{z_1} = \sin\alpha \overrightarrow{x_0} + \cos\alpha \overrightarrow{z_0} & (\times h). \end{array} \right.$$

$$\Rightarrow \left| \begin{array}{l} \lambda \cos\beta = L + h \sin\alpha. \\ -\lambda \sin\beta = h \cos\alpha. \end{array} \right.$$

2 equations, 3 inconnues (λ, α, β).

On cherche $\lambda = \text{fonc}(\beta, \text{cte})$

Il faut "éliminer" λ.

$$\left| \begin{array}{l} \lambda \sin\beta = -h \cos\alpha \\ \lambda \cos\beta = L + h \sin\alpha \end{array} \right.$$

$$\left| \begin{array}{l} \tan\beta = \dfrac{-h\cos\alpha}{L + h\sin\alpha}. \quad \Rightarrow \beta = \arctan(\ldots) \\ \lambda^2 = (h\cos\alpha)^2 + (L + h\sin\alpha)^2 \Rightarrow \lambda = \sqrt{} \end{array} \right.$$

(Q2) On isole le vérin (2+3), soumis à 2 forces

$\Rightarrow$ … Ces 2 forces sont = et directement opposés.

(2)

(Q3) <u>Equation demandée</u> ... $A_5 \dfrac{d^2\alpha}{dt^2} = \dots$

On isole (1), ensemble siège + conducteur

TMD en O sur $(O,\vec{y_0})$

$$J\ddot{\alpha} = \sum \vec{\Gamma}(O) \cdot \vec{y_0}$$

$$\vec{\Gamma}_{pes}(O) = \vec{OG} \wedge \vec{P} = d\vec{z_1} \wedge (-mg\vec{z_0})$$

$$= mgd \sin\alpha \cdot \vec{y_0}$$

$$\vec{\Gamma}_{2\to 1}(O) = \vec{OA} \wedge \vec{F_{21}}$$

$$\Gamma \quad = h\vec{z_1} \wedge F\vec{x_3} = hF\sin\left(\frac{\pi}{2} + \beta - \alpha\right)\vec{y_0}$$

$$= hF\cos(\beta - \alpha)\vec{y_0}$$

$$\Rightarrow \underbrace{J\ddot{\alpha}}_{A_5} = \underbrace{h}_{B_5}F\cos(\beta-\alpha) + \underbrace{mgd}_{C_5}\sin\alpha.$$

(Q4) $a = h\ddot{\alpha} - g\sin\alpha \Rightarrow \ddot{\alpha} = \dfrac{a + g\sin\alpha}{h}$

$$F = \frac{A\ddot{\alpha} - C\sin\alpha}{B\cos(\beta-\alpha)}.$$

$$\ddot{\alpha} = \frac{-2{,}2 + 10 \times \sin 13}{0{,}7} = 0{,}071$$

$$F = \frac{10 \times 0{,}071 - 350 \times \sin 13}{0{,}7 \times \cos 51} = -177 \text{ N}$$

Q5 On a $\dot{\lambda} = K_\alpha . \dot{\alpha}$

Système vis/écrou $\Rightarrow$ $\dot{\lambda} = \frac{1}{2\pi} . \omega_{mot}$

$$\Rightarrow K_\alpha . \dot{\alpha} = \frac{1}{2\pi} . \omega_{mot} \Rightarrow \quad \dot{\alpha} = \frac{1}{2\pi K_\alpha} \omega_{mot}$$

$$\dot{\alpha} = k_T \omega_{mot} \qquad k_T = \frac{1}{2\pi . K_\alpha}$$

Q6 Calcul E_c $\Rightarrow$ ensemble | rotor + vis ; neige + conducteur.

$$E_c = \frac{1}{2} J_{mot} \omega_{mot}^2 + \frac{1}{2} J . \dot{\alpha}^2$$

$$E_c = \frac{1}{2} \left(J_{mot} + k_T^2 J \right) \omega_{mot}^2 = \frac{1}{2} J_{equi} \omega_{mot}^2$$

Q7 TEC : $P_{moteur} = C_{mot} \omega_{mot}$.

$$P_{frott} = - f . \omega_{mot}^2$$

$$P_{pes} = \vec{P} . \vec{v} = - mg \vec{z_0} . d\dot{\alpha} \vec{x_1} = - mg d\dot{\alpha} \cos(\alpha + \frac{\pi}{2})$$
$$= mg d \dot{\alpha} \sin \alpha$$

Rem : $\vec{OG} = d\vec{z_1} \Rightarrow \vec{v}(G \in 1/0) = d\dot{\alpha} \vec{x_1}$

$$\text{TEC} \Rightarrow J_{equi} . \cancel{\omega_{mot}} \dot{\omega}_{mot} = C_{mot} \cancel{\omega_{mot}} - f \omega_{mot}^{\cancel{2}} + mg d \, k_T \cancel{\omega_{mot}} \sin \alpha . \quad \sin\alpha \simeq \alpha = k_T \theta_{mot}$$

$$\Rightarrow J_{equi} \dot{\omega}_{mot} = C_{mot} - f . \omega_{mot} + \underbrace{mg d \, k_T^2}_{K} \theta_{mot}$$

Q8 $C_{mot} = k_i . i(t)$

$$J_{eq} \ddot{\theta}_{mot} + f \dot{\theta}_{mot} - K \theta_{mot} = k_i . i(t) \Rightarrow \frac{\theta_{mot}(p)}{I(p)} = \frac{k_i}{J_e p^2 + f p - K}$$