Q1 : $\vec{\Omega}_{1/0} = \dot{\psi}\, \vec{z}_1$; $\vec{\Omega}_{2/0} = \dot{\psi}\, \vec{z}_1 + \dot{\theta}_2\, \vec{y}_1 = \left|\begin{array}{l} -\dot{\psi}\sin\theta_2 \\ \dot{\theta}_2 \\ \dot{\psi}\cos\theta_2 \end{array}\right._2$

Q2 : $\vec{V}_{G_2 \in 2/0} = \left|\begin{array}{l} b_2\dot{\theta}_2 \\ (a_2 + b_2\sin\theta_2)\dot{\psi} \\ 0 \end{array}\right._2$

Q3 : On isole S_2 ; on applique le th. du mt dynamique en O_2 en projection sur $\vec{y}_1$

Q.4 : $\vec{\delta}_{O_2,2/0} \cdot \vec{y}_1 = \vec{\mathcal{M}}_{O_2}(\text{Poids})\, \vec{y}_1 + C_{m_2}$

$$B_2\ddot{\theta}_2 = C_{m_2} + b_2 M_2\, g \sin\theta_2$$

soit $C_{m_2} = B_2\ddot{\theta}_2 - b_2\sin\theta_2\, M_2\, g$

$C_{m_3} = B_3\ddot{\theta}_3 - b_3 M_3\, g\sin\theta_3$

Q.5 :

$$\vec{a}_{G_2,2/0} = \left|\begin{array}{l} -\omega^2 (a_2 + b_2\sin\theta_2)\cos\theta_2 + b_2\ddot{\theta}_2 \\ 2b_2\,\omega\,\dot{\theta}_2\cos\theta_2 \\ -(a_2 + b_2\sin\theta_2)\,\omega^2\sin\theta_2 - b_2\dot{\theta}_2^2 \end{array}\right._2$$

Q6 : $\vec{\sigma}_{O_1,S_1/0} = I_1\,\omega\,\vec{z}_1$; $\vec{\delta}_{O_1,S_1/0} = \vec{0}$

Q7 :

$$\vec{\sigma}_{O_2,2/0} = \left|\begin{array}{l} -(A_2\sin\theta_2 + M_2 a_2 b_2)\,\omega \\ B_2\dot{\theta}_2 \\ C_2\,\omega\cos\theta_2 \end{array}\right._2$$

O_2 n'est pas un pt fixe.

Q8 :

$$\vec{\delta}_{O_2,S_2/0} = \left|\begin{array}{l} (C_2 - A_2 - B_2)\cos\theta_2\,\omega\,\dot{\theta}_2 \\ B_2\ddot{\theta}_2 + \left[(C_2 - A_2)\sin\theta_2 - M_2 a_2 b_2\right]\omega^2\cos\theta_2 \\ (A_2 - C_2 - B_2)\sin\theta_2\,\omega\,\dot{\theta}_2 \end{array}\right._2$$

Q9 : Calcul en O_1 et projection sur R_1 avec $b_2 = 0$ on obtient $\vec{O_1O_2} \wedge M_2\,\vec{a}_{G_2/0} = \vec{0}$

$$\vec{\delta}_{O_1,S_2/0} = \begin{vmatrix} (I_2\cos^2\theta_2 + J_2\sin^2\theta_2)\,\omega\,\dot{\theta}_2 = D_1 \\ B_2\ddot{\theta}_2 + (C_2-A_2)\sin\theta_2\cos\theta_2\,\omega^2 = D_2 \\ (J_2 - I_2)\cos\theta_2\sin\theta_2\,\omega\,\dot{\theta}_2 = D_3 \end{vmatrix}_1 \quad \text{avec } I_2 = C_2 - A_2 - B_2, \quad J_2 = A_2 - C_2 - B_2$$

Q10 : On isole S_2 et on écrit $\vec{\delta}_{O_2,2/0}\cdot\vec{y}_1 = \vec{M}_{O_2}(\text{Poids de } S_2)\cdot\vec{y}_1 + C_{m_2}$

On isole S_3 $\vec{\delta}_{O_3,3/0}\cdot\vec{y}_1 = \vec{M}_{O_3}(\text{Poids de } S_3)\vec{y}_1 + C_{m_3}$

On isole $S_1+S_2+S_3$ et on écrit.

$$\left(\vec{\delta}(O_1,2/0) + \vec{\delta}_{O_1,3/0}\right)\cdot\vec{z}_1 = C_{m_1} \qquad \text{car } \vec{\delta}_{O_1,S_1/0} = \vec{0}$$

Q11 :

$$\boxed{C_{m_2} = B_2\ddot{\theta}_2 + (C_2-A_2)\sin\theta_2\cos\theta_2\,\omega^2 = D_2}$$

$$C_{m_3} = B_3\ddot{\theta}_3 + (C_3-A_3)\sin\theta_3\cos\theta_3\,\omega^2 = D_5$$

et $C_{m_1} = D_3 + D_6$; $C_{m_2} = D_2$; $C_{m_3} = D_5$

Q.12 : l'équation $C_{m_1} = D_3 + D_6$ reste identique.

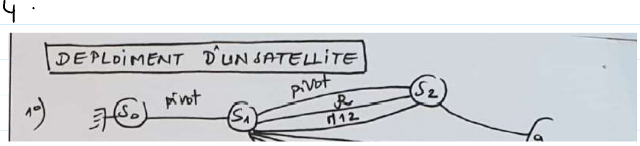
$C_{m_2} = D_2 + k\theta_2 + \gamma\dot{\theta}_2$ et $C_{m_3} = D_3 + k\theta_3 + \gamma\dot{\theta}_3$

Q.13 : Si on isole un des bras, les inconnues de liaison de $S_1 \to S_2$ vont développer une puissance extérieure. Cette puissance est, pour le bras 2

$$\mathcal{P}_{ext\, S_1\to S_2} = \vec{V}_{O_2,2/0}\cdot\vec{R}_{1/2} + \vec{\Omega}_{2/0}\cdot\vec{M}_{O_2}\text{ de } S_1 \to S_2$$

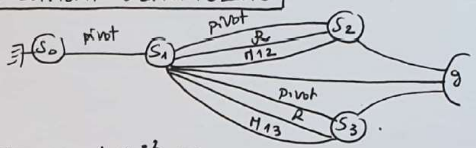
Donc on ne peut isoler que le système entier $S_1+S_2+S_3$

Q.14 :



$\boxed{\text{DEPLOIMENT D'UN SATELLITE}}$

1°)



2°) $T(\Sigma/R_0) = \frac{1}{2} C_1 \dot{\psi}^2 + \underbrace{T(S_2/R_0)}_{} + T(S_3/R_0)$.

$$\underbrace{\frac{1}{2}\{\mathcal{V}(S_2/R_0)\}.\{\mathcal{C}(S_2/R_0)\}}_{}$$

$$\frac{1}{2}\left\{\begin{matrix}\vec{\Omega}(2/0)\\ \vec{V}(G_2/0)\end{matrix}\right\}.\left\{\begin{matrix}m_2 \vec{V}(G_2/0)\\ \vec{\sigma}(G_2, 2/0)\end{matrix}\right\}_{G_2}$$

$$\vec{\Omega}(2/0) = \dot{\psi}\,\vec{z}_0 + \dot{\theta}_2 \vec{y}_1 = \dot{\theta}_2 \vec{y}_2 + \dot{\psi}(\cos\theta_2 \vec{z}_2 - \sin\theta_2 \vec{x}_2)$$

$$\vec{V}(G_2/0) = \frac{d}{dt}(\vec{OG_2})\Big]_{R_0} = b_2 \dot{\theta}_2 \vec{x}_2 + (a_2 + b_2 \sin\theta_2)\dot{\psi}\,\vec{y}_1$$

$$\vec{\sigma}(G_2, 2/0) = \begin{pmatrix} A_2 & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & C_2 \end{pmatrix}_{R_2} . \begin{pmatrix} -\dot{\psi}\sin\theta_2 \\ \dot{\theta}_2 \\ \dot{\psi}\cos\theta_2 \end{pmatrix}_{R_2}$$

$$= -A_2 \dot{\psi} \sin\theta_2 \vec{x}_2 + B_2 \dot{\theta}_2 \vec{y}_2 + C_2 \dot{\psi} \cos\theta_2 \vec{z}_2$$

$$\vec{\sigma}(G_2, 2/0) \cdot \vec{\Omega}(2/0) = B_2 \dot{\theta}_2^2 + (A_2 \sin^2\theta_2 + C_2 \cos^2\theta_2)\dot{\psi}^2$$

$$T(2/R_0) = \frac{m_2}{2}\left[(a_2 + b_2 \sin\theta_2)^2 . \dot{\psi}^2 + b_2^2 . \dot{\theta}_2^2\right] + \frac{1}{2}\left[B_2 \dot{\theta}_2^2 + (A_2 \sin^2\theta_2 + C_2 \cos^2\theta_2)\dot{\psi}^2\right]$$

et

$$T(3/R_0) = \frac{m_3}{2}\left[(a_3 + b_3 \sin\theta_3)^2 . \dot{\psi}^2 + b_3^2 \dot{\theta}_3^2\right] + \frac{1}{2}\left[B_3 \dot{\theta}_3^2 + (A_3 \sin^2\theta_3 + C_3 \cos^2\theta_3)\dot{\psi}^2\right]$$

D'où : $T(\Sigma/R_0) = \frac{1}{2} C_1 \dot{\psi}^2 + T(2/R_0) + T(3/R_0)$.

3°) $P(\bar{\Sigma} \to \Sigma/R_0) = P(S_0 \xrightarrow{Piv} S_1/R_0) + \underbrace{P(g \to \Sigma/R_0)}_{-\frac{d}{dt}\underbrace{V(g \to \Sigma/R_0)}_{\underbrace{-m_2 \vec{g} . \vec{O_1G_2} - m_3 \vec{g} . \vec{O_1G_3}}_{m_2 g b_2 \cos\theta_2 + m_3 g b_3 \cos\theta_3}}}$

$$P(\bar{\Sigma} \to \Sigma/R_0) = g\left[m_2 b_2 \dot{\theta}_2 \sin\theta_2 + m_3 b_3 \dot{\theta}_3 \sin\theta_3\right]$$

4°) $P_{int} = -\upsilon \dot{\theta}_2^2 + C_{m_2} \dot{\theta}_2 - k_2 \theta_2 \dot{\theta}_2 - \upsilon \dot{\theta}_3^2 + C_{m_3} . \dot{\theta}_3 - k_3 \theta_3 \dot{\theta}_3$

5°) $\frac{d}{dt} T(\Sigma/R_0) = P_{ext} + P_{int}$