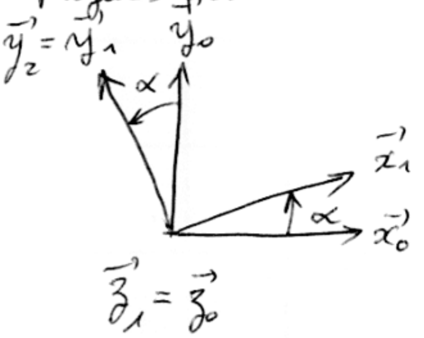
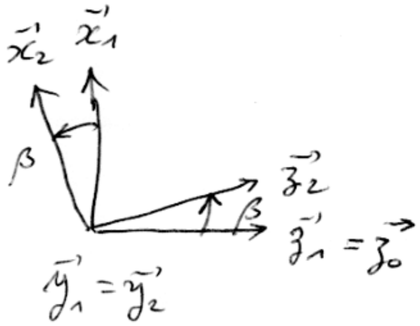
11h30 Figures planes

(1)





(2) Vitesses de rotation

$\boxed{\vec{\Omega}_{1/0} = \dot{\alpha}\,\vec{z}_1}$

$\boxed{\vec{\Omega}_{2/1} = \dot{\beta}\,\vec{y}_1}$

Composition des vitesses de rotation

$\vec{\Omega}_{2/0} = \vec{\Omega}_{2/1} + \vec{\Omega}_{1/0}$

$\boxed{\vec{\Omega}_{2/0} = \dot{\alpha}\,\vec{z}_1 + \dot{\beta}\,\vec{y}_1}$

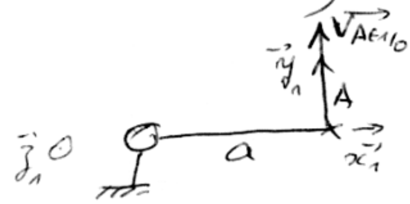
(3) $V_{A\in 1/0}$ ⊥ à (OA) → sur $\vec{y}_1$

Varignon :

11h33 (4) $\vec{V}_{A\in 1/0} = \vec{V}_{O\in 1/0} + \vec{AO} \wedge \vec{\Omega}_{1/0} = -a\vec{x}_1 \wedge \dot{\alpha}\,\vec{z}_1$

$\vec{0}$ car pivot en O entre 1 et 0

$\vec{x}_1 \wedge \vec{z}_1 = -\vec{y}_1$



donc $\boxed{\vec{V}_{A\in 1/0} = a\,\dot{\alpha}\,\vec{y}_1}$

$\vec{V}_{A\in 1/0} = \vec{V}_{A\in 2/0}$ car 1 et 2 en pivot en A ($\vec{V}_{A\in 1/2} = \vec{0}$) $\boxed{\vec{V}_{A\in 2/0} = a\,\dot{\alpha}\,\vec{y}_1}$

(5) Varignon $\vec{V}_{G\in 2/0} = \vec{V}_{A\in 2/0} + \vec{GA} \wedge \vec{\Omega}_{2/0}$

$\vec{V}_{G\in 2/0} = a\,\dot{\alpha}\,\vec{y}_1 + -b\vec{x}_2 \wedge \left(\dot{\alpha}\,\vec{z}_1 + \dot{\beta}\,\vec{y}_1\right)$

avec $\begin{cases} \vec{x}_2 \wedge \vec{z}_1 = -\cos\beta\,\vec{y}_1 \\ \vec{x}_2 \wedge \vec{y}_1 = \vec{x}_2 \wedge \vec{y}_2 = \vec{z}_2 \end{cases}$

11h40 d'où $\boxed{\vec{V}_{G\in 2/0} = (a + b\cos\beta)\,\dot{\alpha}\,\vec{y}_1 - b\,\dot{\beta}\,\vec{z}_2}$

15h00

6) Accélération

$$\overrightarrow{a_{G\in 2/0}} = \left(\frac{d\overrightarrow{V_{G\in 2/0}}}{dt}\right)_0 = \frac{d}{dt}\left((a+b\cos\beta)\dot\alpha\,\vec{y_1} - b\dot\beta\,\vec{z_2}\right)_0$$

$$\overrightarrow{a_{G\in 2/0}} = (-b\sin\beta\,\dot\beta)\dot\alpha\,\vec{y_1} + (a+b\cos\beta)\ddot\alpha\,\vec{y_1} + (a+b\cos\beta)\dot\alpha\left(\frac{d\vec{y_1}}{dt}\right)_0$$
$$-b\ddot\beta\,\vec{z_2} - b\dot\beta\left(\frac{d\vec{z_2}}{dt}\right)_0$$

Bour

- $\left(\frac{d\vec{y_1}}{dt}\right)_0 = \overrightarrow{\Omega_{1/0}} \wedge \vec{y_1} = \dot\alpha\,\vec{z_1} \wedge \vec{y_1} = -\dot\alpha\,\vec{x_1}$
- $\left(\frac{d\vec{z_2}}{dt}\right)_0 = \overrightarrow{\Omega_{2/0}} \wedge \vec{z_2} = (\dot\alpha\,\vec{z_1} + \dot\beta\,\vec{y_1}) \wedge \vec{z_2}$

$\left(\frac{d\vec{z_2}}{dt}\right)_0 = \dot\alpha\sin\beta\,\vec{y_1} + \dot\beta\,\vec{x_2}$

$$\overrightarrow{a_{G\in 2/0}} = (-b\sin\beta\dot\beta)\dot\alpha\,\vec{y_1} + (a+b\cos\beta)\ddot\alpha\,\vec{y_1} - (a+b\cos\beta)\dot\alpha^2\,\vec{x_1}$$
$$-b\ddot\beta\,\vec{z_2} - b\dot\beta\dot\alpha\sin\beta\,\vec{y_1} - b\dot\beta^2\,\vec{x_2}$$

$$\boxed{\begin{aligned}\overrightarrow{a_{G\in 2/0}} = & -(a+b\cos\beta)\dot\alpha^2\,\vec{x_1} - b\dot\beta^2\,\vec{x_2} - 2b\sin\beta\,\dot\alpha\dot\beta\,\vec{y_1}\\ & -b\ddot\beta\,\vec{z_2} + (a+b\cos\beta)\ddot\alpha\,\vec{y_1}\end{aligned}}$$

7) $\ddot\alpha = 0$, $\dot\beta = 0$ alors $\boxed{\overrightarrow{a_{G\in 2/0}} = -(a+b\cos\beta)\dot\alpha^2\,\vec{x_1}}$

8) Application numérique

$$a_{G\in 2/0} = (a+b\cos\beta)\dot\alpha^2$$
$$a_{G\in 2/0} = (a+b\cos\beta)\left(\frac{N_{1/0}\pi}{30}\right)^2$$

$\beta=0 \rightarrow a_{G\in 2/0} = (a+b)\left(\frac{N_{1/0}\pi}{30}\right)^2 = (3+1)\left(\frac{42.\pi}{30}\right)^2 = 77 m.s^{-2} \equiv 7{,}9g$

$\beta=\frac{\pi}{2} \rightarrow a_{G\in 2/0} = a\left(\frac{N_{1/0}\pi}{30}\right)^2 = 3\left(\frac{42\pi}{30}\right)^2 = 57{,}8 m.s^{-2} \equiv 5{,}9g$

On peut ainsi réaliser un essai à 8g et un essai à 6g sans modifier la vitesse de rotation ~~des~~ bras : il faut changer la position β de la cabine du pilote.

15h18