Ex 1

2. $\overrightarrow{V_{O_2/0}} = \left.\dfrac{d\overrightarrow{OO_2}}{dt}\right|_0 = \left.\dfrac{d(\overrightarrow{OO_1} + \overrightarrow{O_1O_2})}{dt}\right|_0$

$= \left.\dfrac{d(\lambda(t)\vec{x_1} + a_1\vec{x_1} + b_1\vec{y_1})}{dt}\right|_0$

$= \left.\dfrac{d((\lambda(t) + a_1)\vec{x_1} + b_1\vec{y_1})}{dt}\right|_0$

$= \dot{\lambda}\vec{x_1} + (\lambda(t) + a_1)\left.\dfrac{d\vec{x_1}}{dt}\right|_0 + b_1\left.\dfrac{d\vec{y_1}}{dt}\right|_0$

$\left.\dfrac{d\vec{x_1}}{dt}\right|_0 = \left.\dfrac{d\vec{x_1}}{dt}\right|_1 + \overrightarrow{\Omega_{1/0}} \wedge \vec{x_1}$

$= \vec{0} + \dot{\alpha}\vec{z} \wedge \vec{x_1} = \dot{\alpha}\vec{y_1} = 0$ car $\alpha = cte$

$\overrightarrow{V_{O_2/0}} = \dot{\lambda}(t)\vec{x_1}$

$\overrightarrow{V_{G/0}} = \left.\dfrac{d\overrightarrow{OG}}{dt}\right|_0 = \left.\dfrac{d\overrightarrow{OO_2}}{dt}\right|_0 + \left.\dfrac{d\overrightarrow{O_2G}}{dt}\right|_0$

$= \dot{\lambda}(t)\vec{x_1} + \left.\dfrac{d(a_2\vec{x_2})}{dt}\right|_0$

$= \dot{\lambda}(t)\vec{x_1} + a_2\left.\dfrac{d\vec{x_2}}{dt}\right|_0$

$\left.\dfrac{d\vec{x_2}}{dt}\right|_0 = \left.\dfrac{d\vec{x_2}}{dt}\right|_2 + \overrightarrow{\Omega_{2/0}} \wedge \vec{x_2}$

$= (\dot{\alpha} + \dot{\beta})\vec{z} \wedge \vec{x_2} = \dot{\beta}\vec{y_2}$

$\overrightarrow{V_{G/0}} = \dot{\lambda}(t)\vec{x_1} + \dot{\beta}a_2\vec{y_2}$

3. $\overrightarrow{a_{G/0}} = \left.\dfrac{d\overrightarrow{V_{G/0}}}{dt}\right|_0 = \ddot{\lambda}\vec{x_1} + \ddot{\beta}a_2\vec{y_2} + \dot{\beta}a_2\left.\dfrac{d\vec{y_2}}{dt}\right|_0$

$= \ddot{\lambda}\vec{x_1} + \ddot{\beta}a_2\vec{y_2} + \dot{\beta}a_2(\overrightarrow{\Omega_{2/0}} \wedge \vec{y_2})$

$= \ddot{\lambda}\vec{x_1} + \ddot{\beta}a_2\vec{y_2} + \dot{\beta}^2a_2(-\vec{x_2})$

4. $\vec{x_1} \cdot \vec{y_2} = -\sin\beta$ donc

Ex 2

1. $\overrightarrow{OM} = \overrightarrow{OA} + \overrightarrow{AM}$

$= h\,\vec{z_0} + \lambda(t)\,\vec{x_0} + R\,\vec{x_2}$

2. $\overrightarrow{\Omega_{1/0}} = \vec{0}$

$\overrightarrow{\Omega_{2/1}} = \dot{\theta}\,\vec{z}$

$\overrightarrow{\Omega_{2/0}} = \dot{\theta}\,\vec{z}$

3. $\overrightarrow{V_{M/0}} = \left.\dfrac{d\,OM}{dt}\right|_0 = \dfrac{d(h\vec{z_0} + \lambda(t)\vec{x_0} + R\vec{x_2})}{dt}$

$= \dot{\lambda}(t)\,\vec{x_0} + R\left.\dfrac{d\vec{x_2}}{dt}\right|_0$

$= \dot{\lambda}\,\vec{x_0} + R.\,\overrightarrow{\Omega_{2/0}} \wedge \vec{x_2}$

$= \dot{\lambda}\,\vec{x_0} + R.\,\dot{\theta}\,\vec{z} \wedge \vec{x_2}$

$= \dot{\lambda}\,\vec{x_0} + R\dot{\theta}\,\vec{y_2} = \dot{\lambda}\,\vec{x_0} + R\omega\,\vec{y_2}$

5. $\overrightarrow{V_{M/0}} = \dot{\lambda}\,\vec{x_0} + R\omega(-\sin\theta\,\vec{x_0} + \cos\theta\,\vec{y_0})$

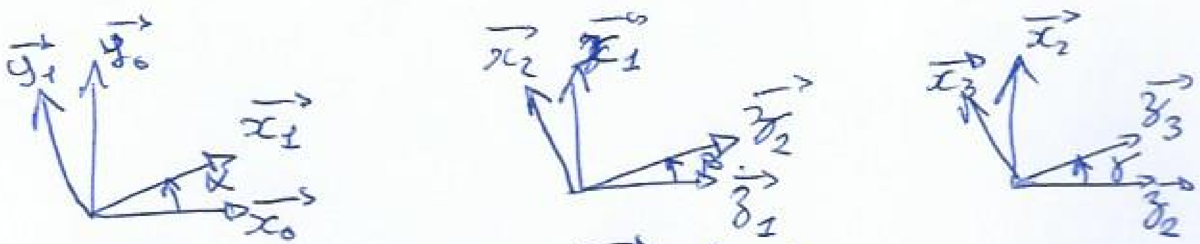
Max pour $\theta = -\dfrac{\pi}{2}$ On a alors

$V_{Max} = \dot{\lambda} + R\omega.$

6. $\dot{\lambda} = V_{Max} - R\omega$

Ex 3

1.



$\overrightarrow{\Omega_{1/0}} = \dot{\alpha}\,\vec{z_0}$ $\qquad$ $\overrightarrow{\Omega_{2/1}} = \dot{\beta}\,\vec{y_1}$

2. $\overrightarrow{V_{C/0}}$ $\quad \overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AB} + \overrightarrow{BC}$

$= h\,\vec{z_0} + H\,\vec{z_2} + L\,\vec{z_3}$

$= h\,\vec{z_0} + H(\cos\beta\,\vec{z_1} + \sin\beta\,\vec{x_1}) +$

$L(\cos\gamma\,\vec{z_2} + \sin\gamma\,\vec{x_2})$

$$\overrightarrow{OC} = h\vec{z_0} + H(\cos\beta\,\vec{z_0} + \sin\beta\cos\alpha\,\vec{z_0} + \sin\beta\sin\alpha\,\vec{x_0}) \quad (3)$$
$$+ L(\cos\gamma\cos\beta\,\vec{z_0} + \cos\gamma\sin\beta\cos\alpha\,\vec{z_0} + \cos\gamma\sin\beta\sin\alpha\,\vec{x_0} + \sin\gamma(\cos\beta\,\vec{x_1} - \sin\beta\,\vec{z_1})$$

$$= h\vec{z_0} + H(\cos\beta\,\vec{z_0} + \sin\beta\cos\alpha\,\vec{z_0} + \sin\beta\sin\alpha\,\vec{x_0}) + L(\cos\gamma\cos\beta\,\vec{z_0} + \cos\gamma\sin\beta\cos\alpha\,\vec{z_0} + \cos\gamma\sin\beta\sin\alpha\,\vec{x_0} + \sin\gamma\cos\beta(\cos\alpha\,\vec{x_0} + \sin\alpha\,\vec{y_0}) - \sin\gamma\sin\beta\,\vec{z_0}$$

$$= \left|\begin{array}{l} H\sin\beta\sin\alpha + L\cos\gamma\sin\beta\sin\alpha + L\sin\gamma\cos\beta\cos\alpha \\ L\sin\gamma\cos\beta\sin\alpha \\ h + H\cos\beta + H\sin\beta\cos\alpha + L\cos\gamma\cos\beta + L\cos\gamma\sin\beta\cos\alpha + L\sin\gamma\sin\beta \end{array}\right._{0}$$

3. $$\overrightarrow{V_{C/0}} = \left|\begin{array}{l} H\dot\beta\cos\beta\sin\alpha + H\dot\alpha\sin\beta\cos\alpha + L(-\dot\gamma\sin\beta\sin\gamma\sin\alpha + \cos\gamma\dot\beta\sin\beta\cos\alpha + \dot\alpha\sin\gamma\cos\beta\cos\alpha) \\ + L(\sin\gamma\cos\beta\dot\alpha\sin\alpha - \dot\beta\sin\gamma\sin\beta\cos\alpha + \dot\gamma\cos\gamma\cos\beta\cos\alpha) \\ L(\dot\gamma\cos\gamma\cos\beta\sin\alpha + \dot\alpha\sin\gamma\cos\beta\cos\alpha - \dot\beta\sin\gamma\sin\beta\sin\alpha) \end{array}\right._{0}$$

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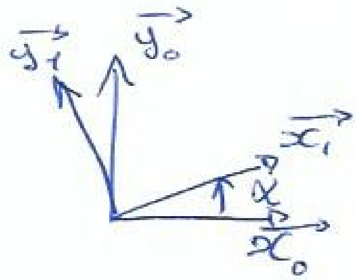
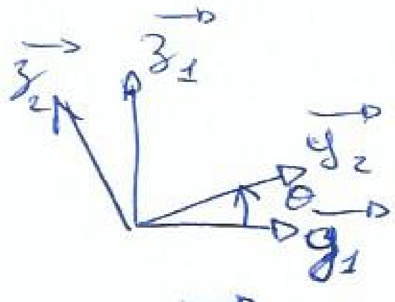
Ex 4

1. Rotations

2. Cercles

3.





4. $\overrightarrow{\Omega_{1/0}} = \dot\alpha\,\vec{z_0}$ $\qquad$ $\overrightarrow{\Omega_{2/1}} = \dot\theta\,\vec{x_1}$

5. $\overrightarrow{\Omega_{2/0}} = \overrightarrow{\Omega_{2/1}} + \overrightarrow{\Omega_{1/0}}$
$= \dot\alpha\,\vec{z_0} + \dot\theta\,\vec{x_1}$

6. $\vec{V}_{G_2/0} = \left.\dfrac{d\vec{OG_2}}{dt}\right|_0$

$= \left.\dfrac{d(\vec{OB} + \vec{BG_2})}{dt}\right|_0$

$= \left.\dfrac{d(b\vec{z_2} + a\vec{x_1})}{dt}\right|_0$

$= b\left.\dfrac{d\vec{z_2}}{dt}\right|_0 + a\left.\dfrac{d\vec{x_1}}{dt}\right|_0$

$= b.\vec{\Omega}_{2/0} \wedge \vec{z_2} + a\vec{\Omega}_{1/0} \wedge \vec{x_1}$

$= b.(\dot{\alpha}\vec{z_0} + \dot{\theta}\vec{x_1}) \wedge \vec{z_2} + a\dot{\theta}\vec{x_1} \wedge \vec{x_1}$

$= -b.\dot{\alpha}\sin\theta\,\vec{x_2} + b\dot{\theta}(-\vec{y_2})$

$\vec{z_0} = \cos\theta\,\vec{z_2} - \sin\theta\,\vec{y_2}$

7. $\left.\dfrac{d\vec{V}_{G_2/0}}{dt}\right|_0 = \vec{a}_{G_2/0}$

$= -b\ddot{\alpha}\sin\theta\,\vec{x_2} - b\dot{\alpha}\dot{\theta}\sin\theta\,\vec{x_2} - b\dot{\alpha}\sin\theta\left.\dfrac{d\vec{x_2}}{dt}\right|_0 + b\ddot{\theta}(-\vec{y_2}) - b\dot{\theta}\dfrac{d\vec{y_2}}{dt}$

$\left.\dfrac{d\vec{x_2}}{dt}\right|_0 = \vec{\Omega}_{2/0} \wedge \vec{x_2} = (\dot{\alpha}\vec{z_0} + \dot{\theta}\vec{x_1}) \wedge \vec{x_2}$

$= \dot{\alpha}\vec{z_0} \wedge \vec{x_2} = \dot{\alpha}\vec{y_1}$

$\left.\dfrac{d\vec{y_2}}{dt}\right|_0 = \vec{\Omega}_{2/0} \wedge \vec{y_2} = (\dot{\alpha}\vec{z_0} + \dot{\theta}\vec{x_1}) \wedge \vec{y_2}$

$= -\dot{\alpha}\cos\theta\,\vec{x_2} + \dot{\theta}\vec{z_2}$

$\vec{a}_{G_2/0} = -b\ddot{\alpha}\sin\theta\,\vec{x_2} - b\dot{\alpha}\dot{\theta}\sin\theta\,\vec{x_2} - b\dot{\alpha}\sin\theta(\dot{\alpha}\vec{y_1}) + b\ddot{\theta}(-\vec{y_2}) - b\dot{\theta}(-\dot{\alpha}\cos\theta\,\vec{x_2} + \dot{\theta}\vec{z_2})$