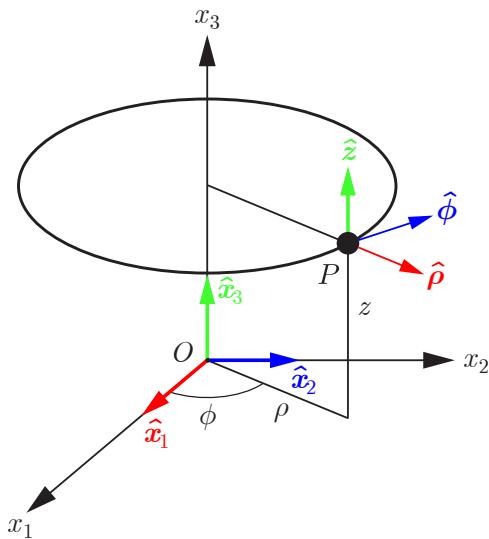
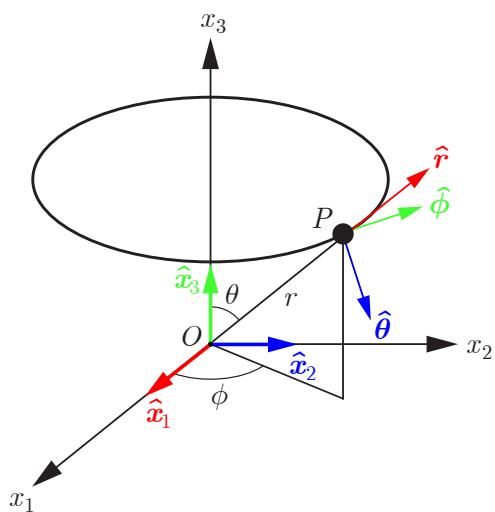


Point matériel

Coordonnées cylindriques :



Coordonnées sphériques :



$$\mathbf{r} = \rho \hat{\rho} + z \hat{z}$$

$$\mathbf{v} = \dot{\rho} \hat{\rho} + \rho \dot{\phi} \hat{\phi} + \dot{z} \hat{z}$$

$$\begin{aligned} \mathbf{a} = & \left(\ddot{\rho} - \rho \dot{\phi}^2 \right) \hat{\rho} + \left(\rho \ddot{\phi} + 2\dot{\rho}\dot{\phi} \right) \hat{\phi} \\ & + \ddot{z} \hat{z} \end{aligned}$$

$$\mathbf{r} = r \hat{r}$$

$$\mathbf{v} = \dot{r} \hat{r} + r \dot{\theta} \hat{\theta} + r \dot{\phi} \sin \theta \hat{\phi}$$

$$\begin{aligned} \mathbf{a} = & \left(\ddot{r} - r \dot{\theta}^2 - r \dot{\phi}^2 \sin^2 \theta \right) \hat{r} \\ & + \left(r \ddot{\theta} + 2\dot{r}\dot{\theta} - r \dot{\phi}^2 \sin \theta \cos \theta \right) \hat{\theta} \\ & + \left(r \ddot{\phi} \sin \theta + 2\dot{r}\dot{\phi} \sin \theta + 2r\dot{\theta}\dot{\phi} \cos \theta \right) \hat{\phi} \end{aligned}$$

Mouvement relatif :

$$\mathbf{v}_a(P) = \mathbf{v}_a(A) + \mathbf{v}_r(P) + \boldsymbol{\Omega} \times \mathbf{AP}$$

$$\mathbf{a}_a(P) = \mathbf{a}_a(A) + \mathbf{a}_r(P) + \boldsymbol{\Omega} \times (\boldsymbol{\Omega} \times \mathbf{AP}) + 2\boldsymbol{\Omega} \times \mathbf{v}_r(P) + \dot{\boldsymbol{\Omega}} \times \mathbf{AP}$$

Formules de Poisson : où $\mathbf{r}_r(P) = \mathbf{AP}$

$$\dot{\hat{\mathbf{u}}} = \boldsymbol{\Omega} \times \hat{\mathbf{u}} \quad \text{où} \quad \hat{\mathbf{u}} \text{ est un vecteur unitaire quelconque}$$

Solide indéformable

Cinématique :

$$\begin{aligned}\mathbf{V}_Q &= \mathbf{V}_P + \boldsymbol{\Omega} \times \mathbf{PQ} \\ \mathbf{A}_Q &= \mathbf{A}_P + \boldsymbol{\Omega} \times (\boldsymbol{\Omega} \times \mathbf{PQ}) + \dot{\boldsymbol{\Omega}} \times \mathbf{PQ}\end{aligned}$$

Théorèmes de transfert du moment cinétique :

$$\mathbf{L}_O = \mathbf{OP} \times M \mathbf{V}_G + \mathbf{L}_P , \quad \mathbf{L}_O = \mathbf{OG} \times M \mathbf{V}_G + \mathbf{L}_G , \quad \mathbf{L}_P = \mathbf{PG} \times M \mathbf{V}_G + \mathbf{L}_G$$

Théorèmes de transfert des moments de force :

$$\begin{aligned}\sum \mathbf{M}_O &= \mathbf{OP} \times M \mathbf{A}_G + \sum \mathbf{M}_P , \quad \sum \mathbf{M}_O = \mathbf{OG} \times M \mathbf{A}_G + \sum \mathbf{M}_G \\ \sum \mathbf{M}_P &= \mathbf{PG} \times M \mathbf{A}_G + \sum \mathbf{M}_G\end{aligned}$$

Théorème du moment cinétique :

$$\sum \mathbf{M}_O^{\text{ext}} = \dot{\mathbf{L}}_O , \quad \sum \mathbf{M}_G^{\text{ext}} = \dot{\mathbf{L}}_G , \quad \sum \mathbf{M}_C^{\text{ext}} = \dot{\mathbf{L}}_C , \quad \sum \mathbf{M}_P^{\text{ext}} = \dot{\mathbf{L}}_P + \mathbf{V}_P \times M \mathbf{V}_G$$

Moment cinétique et moments d'inertie :

$$\mathbf{L}_G = \mathbf{I}_G \boldsymbol{\Omega} = \sum_{i=1}^3 I_{G,i} \Omega_i \hat{\mathbf{e}}_i = I_{G,1} \Omega_1 \hat{\mathbf{e}}_1 + I_{G,2} \Omega_2 \hat{\mathbf{e}}_2 + I_{G,3} \Omega_3 \hat{\mathbf{e}}_3 \quad \text{où} \quad I_{G,i} = \sum_{\alpha} m_{\alpha} r_{\alpha,i}^2$$

Théorème de Huygens-Steiner :

$$I_{A,i} = I_{G,i} + M d^2$$

Quantité de mouvement et énergie cinétique :

$$\mathbf{P} = M \mathbf{V}_G , \quad T = \frac{1}{2} M \mathbf{V}_G^2 + \frac{1}{2} (I_{G,1} \Omega_1^2 + I_{G,2} \Omega_2^2 + I_{G,3} \Omega_3^2)$$

Théorème de l'énergie cinétique :

$$\Delta T_{1 \rightarrow 2} = \sum_{\alpha} W_{1 \rightarrow 2} (\mathbf{F}_{\alpha}^{\text{ext}}) = \sum_{\alpha} \int_{C_{1 \rightarrow 2}} \mathbf{F}_{\alpha}^{\text{ext}} \cdot d\mathbf{r}_{\alpha}$$