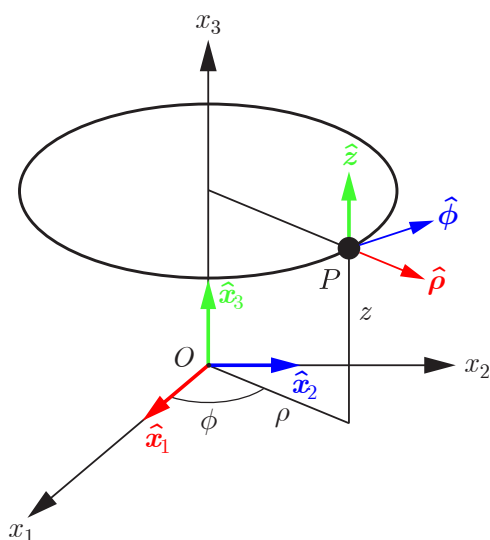


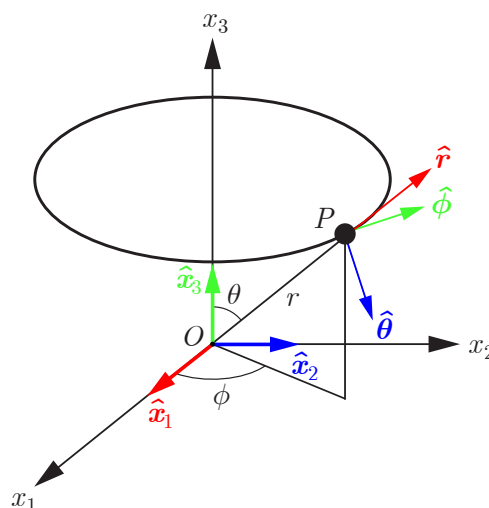
Point matériel

Coordonnées cylindriques :



$$\begin{aligned} \mathbf{r} &= \rho \hat{\boldsymbol{\rho}} + z \hat{\mathbf{z}} \\ \mathbf{v} &= \dot{\rho} \hat{\boldsymbol{\rho}} + \rho \dot{\phi} \hat{\boldsymbol{\phi}} + \dot{z} \hat{\mathbf{z}} \\ \mathbf{a} &= (\ddot{\rho} - \rho \dot{\phi}^2) \hat{\boldsymbol{\rho}} + (\rho \ddot{\phi} + 2\dot{\rho}\dot{\phi}) \hat{\boldsymbol{\phi}} \\ &\quad + \ddot{z} \hat{\mathbf{z}} \end{aligned}$$

Coordonnées sphériques :



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

Mouvement relatif :

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

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 :

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

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 :

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

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 :

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