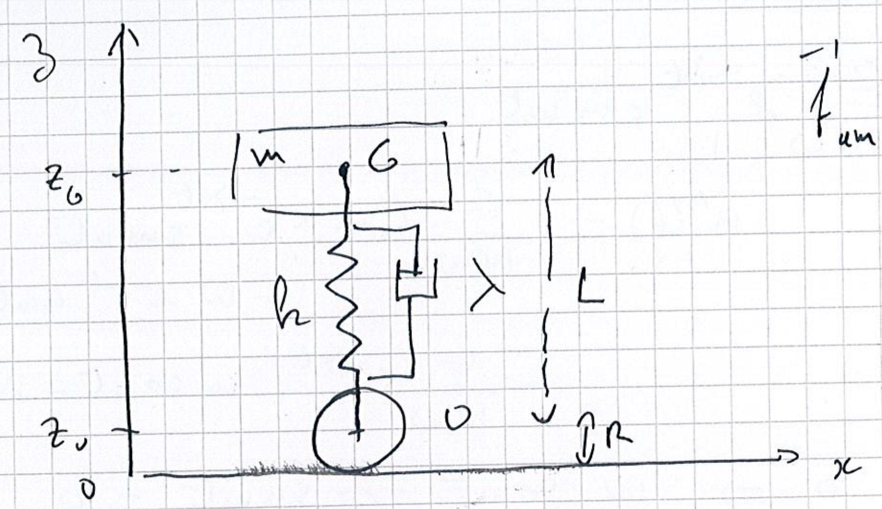
III Suspension de voiture.



$\vec{f}_{am} = -\lambda \frac{dL}{dt}\vec{u}_z$

$L = z_G - z_0$

$z_G = L + R$

$R = z_0$

$L = z_G - R$

1) Equilibre masse m : $z_G = cte$

$\sum \vec{F} = \vec{0}$: $m\vec{g} - k(L-L_0)\vec{u}_z = \vec{0}$

$-mg - k(L-L_0) = 0$

A l'équilibre : $-mg + kL_0 = kL = k(z_{G_0} - R)$

$-mg = k(z_{G_0} - L_0 - R)$

$\Rightarrow z_{G_0} = L_0 - \frac{mg}{k} + R$

2) PFD : système = masse m repérée par z_G

$m\vec{a} = m\vec{g} - k(L-L_0)\vec{u}_z - \lambda \frac{dL}{dt}\vec{u}_z$

$m\ddot{z}_G = -mg - k(z_G - R - L_0) - \lambda \frac{d(z_G - z_0)}{dt}$

$mg = k(z_{G_0} - R - L_0)$

$m\ddot{z}_G = k(z_{G_0} - R - L_0) - k(z_G - R - L_0) - \lambda \frac{d(z_G - z_0)}{dt}$

soit $m\ddot{z}_G = -k(z_G - z_{G_0}) - \lambda \frac{d(z_G - z_0)}{dt}$

On pose $Z = z_G - z_{G_0}$ $\Rightarrow$ $m\ddot{Z} = -kZ - \lambda\dot{Z}$

soit $\boxed{\ddot{Z} + \frac{\lambda}{m}\dot{Z} + \frac{k}{m}Z = 0}$ (*)

Autre méthode via le TEC.

$E_p = mg z_G + \frac{1}{2}k(L-L_0)^2$

$= mg z_G + \frac{1}{2}k(z_G - R - L_0)^2 + cste$

$E_m = \frac{1}{2}m\dot{z}_G^2 + mg z_G + \frac{1}{2}k(z_G - R - L_0)^2 + cste$

et $\frac{dE_m}{dt}$ = puissance force de frott^c

$= -\lambda \frac{dz_G}{dt}\vec{u}_z \cdot \dot{z}_G\vec{u}_z$

$= -\lambda \frac{dz_G}{dt}\dot{z}_G$

On arrive à (*).

On peut poser $2\Lambda = \frac{\lambda}{m}$ et $\omega_0^2 = \frac{k}{m}$

On retrouve l'éq^n standard

$\ddot{Z} + 2\Lambda\dot{Z} + \omega_0^2 Z = 0$

$\Delta = 4(\Lambda^2 - \omega_0^2)$

oscillations amorties : $\Delta < 0 \Leftrightarrow \Lambda^2 < \omega_0^2$ i.e. $\left(\frac{\lambda}{2m}\right)^2 < \frac{k}{m}$

i.e. $\lambda^2 < 4mk$

régime critique $\lambda^2 = 4mk$

régime apériodique $\lambda^2 > 4mk$.