Dinâmica de Sistemas Navais e Oceânicos

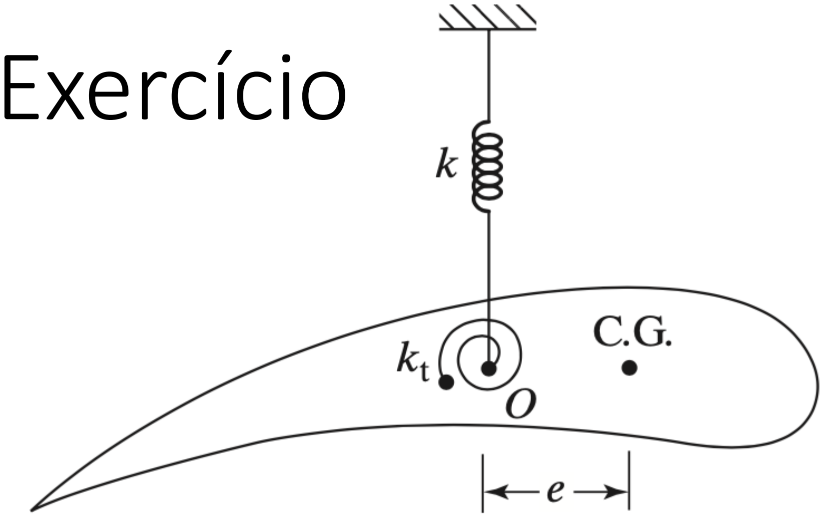
PNV3314 Dinâmica de Sistemas

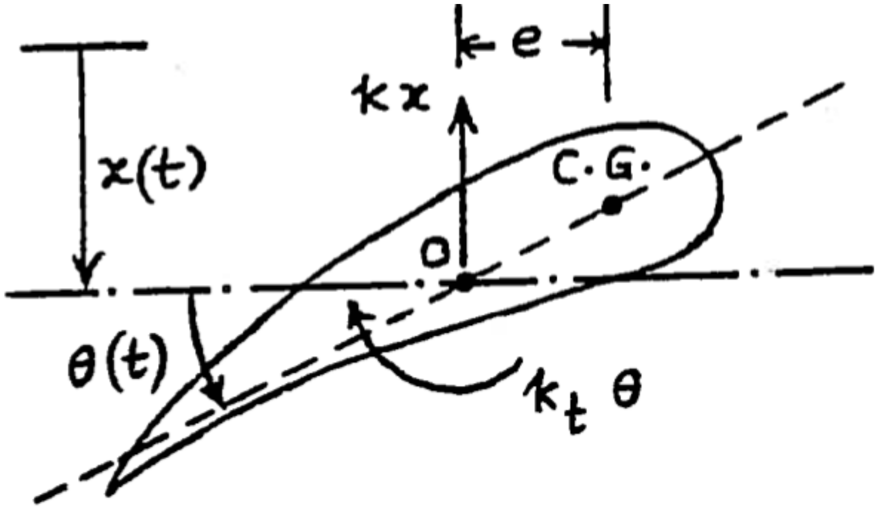
Aula 24

Flutter

- http://www.youtube.com/watch?v=3CMlXyV2XnE
- http://www.youtube.com/watch?v=rb3JHY_-ia4&feature=related

Exercício





Equações do movimento

$$m\ddot{x} - me\ddot{\theta} = -kx + F_x$$

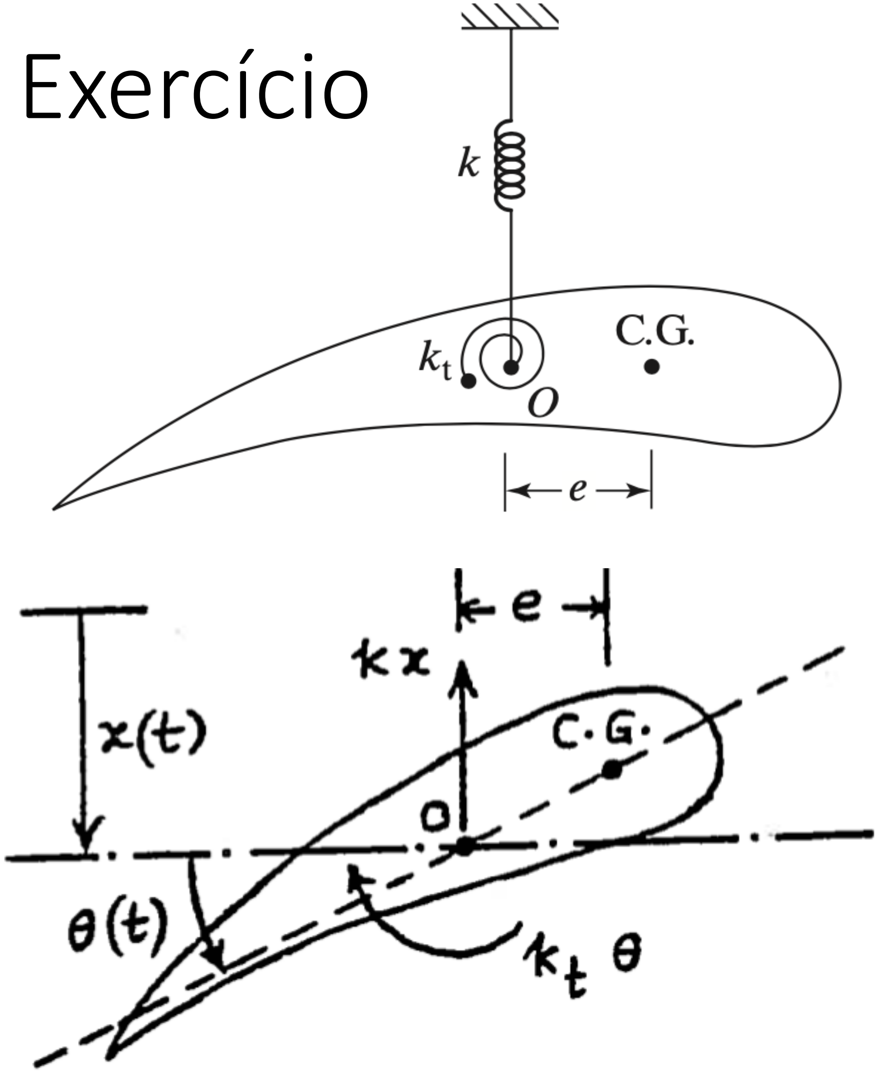
$$J_{CG}\ddot{\theta} = -k_t\theta - kxe + M_\theta$$

Ou...

$$m\ddot{x} + kx - me\ddot{\theta} = F_x$$

$$(J_0 - me^2)\ddot{\theta} + k_t\theta + kxe = M_\theta$$

Exercício



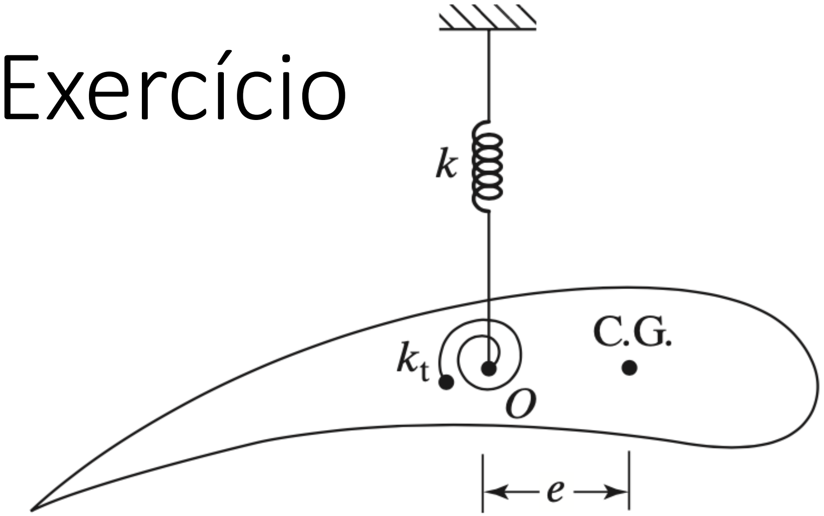
$$m\ddot{x} + kx - me\ddot{\theta} = F_x$$

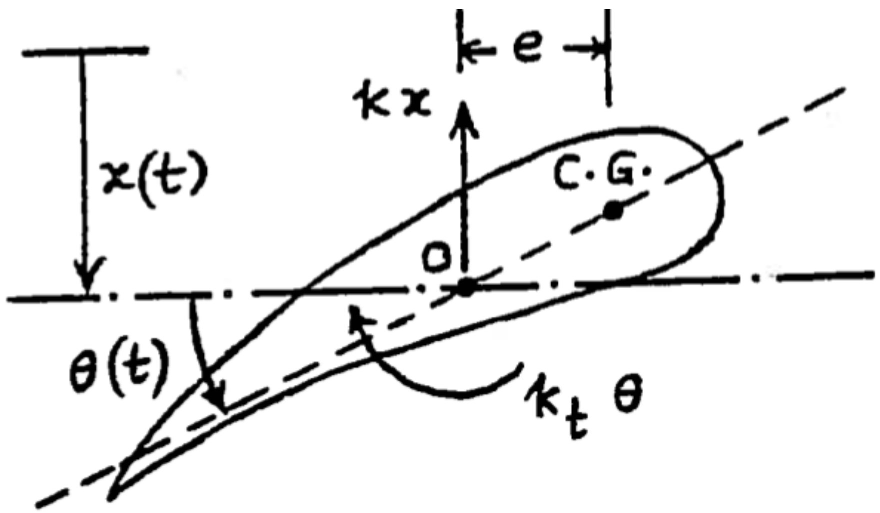
$$(J_0 - me^2)\ddot{\theta} + k_t\theta + kxe = M_\theta$$

Na forma matricial

$$\begin{bmatrix} m & -me \\ 0 & J_0 - me^2 \end{bmatrix}\begin{bmatrix} \ddot{x} \\ \ddot{\theta} \end{bmatrix} + \begin{bmatrix} k & 0 \\ ke & k_t \end{bmatrix}\begin{bmatrix} x \\ \theta \end{bmatrix} = \begin{bmatrix} F_x \\ M_\theta \end{bmatrix}$$

Exercício





$$m\ddot{x} + kx - me\ddot{\theta} = F_x$$

$$(J_0 - me^2)\ddot{\theta} + k_t\theta + kxe = M_\theta$$

Na forma matricial

$$\begin{bmatrix} m & -me \\ 0 & J_0 - me^2 \end{bmatrix} \begin{bmatrix} \ddot{x} \\ \ddot{\theta} \end{bmatrix} + \begin{bmatrix} k & 0 \\ ke & k_t \end{bmatrix} \begin{bmatrix} x \\ \theta \end{bmatrix} = \begin{bmatrix} F_x \\ M_\theta \end{bmatrix}$$

A solução do determinante produz a equação característica com as raízes do sistema (harmônico).

$$\begin{vmatrix} -m\omega^2 + k & me\omega^2 \\ ke & -(J_0 - me^2) + k_t \end{vmatrix} = 0$$