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PME3380 - Modelagem de Sistemas Dinâmicos

Exercício da Aula do dia 17/09/2020

1) Linearização: $f(x) = \cos(x)$

$$f(x) = f(\bar{x}) + \frac{\partial f}{\partial x}\Big|_{\bar{x}} (x - \bar{x}) \therefore f(x) = \cos(\bar{x}) - \operatorname{sen}(\bar{x})(x - \bar{x})$$

a) $\bar{x} = 0$

$$\rightarrow f(x) = \cos(0) - \operatorname{sen}(0)(x - 0) \therefore \boxed{f(x) = 1}$$

b) $\bar{x} = \frac{\pi}{4}$

$$\rightarrow f(x) = \cos\left(\frac{\pi}{4}\right) - \operatorname{sen}\left(\frac{\pi}{4}\right)\left(x - \frac{\pi}{4}\right) \therefore f(x) = \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}\left(x - \frac{\pi}{4}\right) \therefore$$

$$\therefore \boxed{f(x) = \frac{\sqrt{2}}{2}\left[1 - \left(x - \frac{\pi}{4}\right)\right]}$$

2) Linearizar, por expansão de Taylor: $m\dot{v} = F(t) - mru + m\dot{x}\dot{r}$

$$\rightarrow f(\dot{v}, r, \dot{r}, x, u) = -mru + m\dot{x}\dot{r} - m\dot{v} \quad \text{e} \quad \bar{\dot{v}} = \bar{r} = \dot{\bar{r}} = 0$$

$$\hookrightarrow f = \cancel{f(\bar{v})}^{0} + \cancel{\frac{\partial f}{\partial \dot{v}}}^{-m}\Big|_{v=\bar{v}} (\dot{v} - \bar{\dot{v}}) + \cancel{\frac{\partial f}{\partial r}}^{-m\bar{u}}\Big|_{r=\bar{r}} (r - \bar{r}) + \cancel{\frac{\partial f}{\partial \dot{r}}}^{m\bar{x}}\Big|_{\dot{r}=\dot{\bar{r}}} (\dot{r} - \dot{\bar{r}}) + \cancel{\frac{\partial f}{\partial x}}^{m\dot{\bar{r}}}\Big|_{x=\bar{x}} (x - \bar{x}) + \cancel{\frac{\partial f}{\partial u}}^{-m\dot{\bar{r}}}\Big|_{u=\bar{u}} (u - \bar{u})$$

$$f(\dot{v}, r, \dot{r}, x, u) = -m(\dot{v} - \cancel{\dot{\bar{v}}}^{0}) - m\bar{u}(r - \cancel{\bar{r}}^{0}) + m\bar{x}(\dot{r} - \cancel{\dot{\bar{r}}}^{0}) + \cancel{m\dot{\bar{r}}}^{0}(x - \bar{x}) - \cancel{m\dot{\bar{r}}}^{0}(u - \bar{u})$$

$$f(\dot{v}, r, \dot{r}, x, u) = -m\dot{v} - m\bar{u}r + m\bar{x}\dot{r} = -F(t) \therefore \boxed{m\dot{v} = F(t) - m\bar{u}r + m\bar{x}\dot{r}}$$