1bis - ODE-based model example

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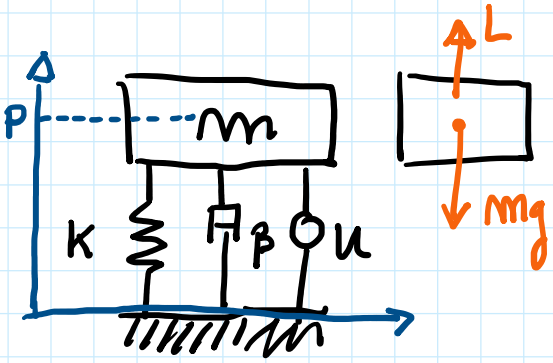

$m, K, \beta, g, l_0 > 0$

m mass

K stiffness of the spring

β damping coefficient

g gravity acc.

$L : \mathbb{R} \to \mathbb{R}$

u: control input (FORCE)

l_0 0-load length

$$\ddot{p} = \frac{d^2 p}{dt^2}$$

$$m\ddot{p} + K(p - l_0) + \beta \dot{p}^3 - u - L + mg = 0$$

$$\dot{x} = f(x, u, w)$$

$\dot{p} := v$ v speed p position

$\ddot{p} = \dot{v}$

$$\begin{cases} \dot{p} = v \\ \dot{v} = -\frac{K}{m}(p - l_0) - \frac{\beta}{m} v^3 + \frac{u}{m} + \frac{L}{m} - \frac{mg}{m} \end{cases}$$

$$\dot{p} = v$$

$$\dot{v} = -\frac{K}{m}(p - l_0) - \frac{\beta}{m} v^3 + \frac{1}{m} u + \frac{1}{m} L - g$$

disturbances

u ← control input

$x := [p \;\; v]$ $d := [L]$

$$x := \begin{bmatrix} p \\ v \end{bmatrix} \qquad d := \begin{bmatrix} L \\ g \end{bmatrix}$$ control input

$y = p + ?$ $\quad ? : \mathbb{R} \to \mathbb{R}$ noise

$e = \cancel{p} - r$ WRONG

$r : \mathbb{R} \to \mathbb{R}$ reference (position)

$= y - r$

$= p + ? - r$

$$w := \begin{bmatrix} d \\ ? \\ r \end{bmatrix}$$ exogenous signals

$$\dot{x} = f(x, u, w)$$

$$f := \begin{bmatrix} v \\ -\frac{\kappa}{m}(p - l_0) - \frac{\beta}{m} v^3 + \frac{1}{m} u + \frac{1}{m} L - g \end{bmatrix}$$

$$y = h(x, u, w) := p + ?$$

$$e = h_e(x, u, w) := p + ? - r$$