NeuralODE with Knowledge

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$$\frac{\mathrm{d}^2P(t)}{\mathrm{d}t^2} + 2\zeta\omega_n\frac{\mathrm{d}P(t)}{\mathrm{d}t} + \omega_n^2 P(t) = K\omega_n^2 I(t),$$

let $v(t) = \dfrac{\mathrm{d}P(t)}{\mathrm{d}t}$, then

$$\begin{cases} \dfrac{\mathrm{d}P(t)}{\mathrm{d}t} = v(t), \\ \dfrac{\mathrm{d}v(t)}{\mathrm{d}t} + 2\zeta\omega_n v(t) + \omega_n^2 P(t) = K\omega_n^2 I(t), \end{cases}$$

therefore

$$\frac{\mathrm{d}}{\mathrm{d}t}\begin{bmatrix} P(t) \\ v(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\omega_n^2 & -2\zeta\omega_n \end{bmatrix}\begin{bmatrix} P(t) \\ v(t) \end{bmatrix} + \begin{bmatrix} 0 \\ K\omega_n^2 \end{bmatrix} I(t).$$

Acknowledgement

Thank you!