Tutorial-1

Course: Dynamics and Control

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Recap Topics Covered

- Systems, Signals, State Space Modelling
- State Space Response, Linearization

Tutorial Example Set: 1

For the following test: time in-variance, homogeneity and additive properties

- y = 2x
- y = x+1
- y = ln(x)
- y = x^3
- y = K exp(x); K is any scalar

Develop state space models of the following inverted pendulum dynamics in MATLAB:

$$\begin{bmatrix} \dot{x} \\ \ddot{x} \\ \dot{\phi} \\ \ddot{\phi} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & \frac{-(I+ml^2)b}{I(M+m)+Mml^2} & \frac{m^2gl^2}{I(M+m)+Mml^2} & 0 \\ 0 & 0 & 0 & 1 \\ 0 & \frac{-mlb}{I(M+m)+Mml^2} & \frac{mgl(M+m)}{I(M+m)+Mml^2} & 0 \end{bmatrix} \begin{bmatrix} x \\ \dot{x} \\ \phi \\ \dot{\phi} \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{I+ml^2}{I(M+m)+Mml^2} \\ 0 \\ \frac{ml}{I(M+m)+Mml^2} \end{bmatrix} u$$

$$\mathbf{y} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ \dot{x} \\ \phi \\ \dot{\phi} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

The parameters of the system are: M = 0.5; m = 0.2; b = 0.1; I = 0.006; g = 9.8; l = 0.3

Consider different initial conditions and inputs as was shown in Tutorial and get the response of the inverted pendulum system for initial, forced and total scenarios.