ME 793 - Phase 01

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system Dynamics

$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

dynamic equation:

$$\ddot{x} = -\frac{1}{m}u_1(t)\sin\theta$$
$$\ddot{z} = \frac{1}{m}u_1(t)\cos\theta - g$$
$$\ddot{\theta} = \frac{1}{I_{xx}}u_2(t)$$

state matrix:

$$x = \begin{bmatrix} x \\ \dot{x} \\ z \\ \dot{z} \\ \theta \\ \dot{\theta} \end{bmatrix}$$

matrices:

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 & 0 \\ -\frac{1}{m}\sin\theta & 0 \\ 0 & 0 \\ \frac{1}{m}\cos\theta & 0 \\ 0 & 0 \\ 0 & \frac{1}{I_{xx}} \end{bmatrix}$$

static unknown coefficient of input matrix

Lets imagine that the coefficient of input matrix is unknown. So, we break down the input matrix into two parts. One part is known and the other part is unknown.

$$\begin{aligned} B_{n\times m} &= B^0_{n\times k} B^1_{k\times m} \\ \text{so,} & \\ \dot{x} &= Ax + B^0 B^1 u \\ &= Ax + B^0 u_B \\ y &= Cx \end{aligned}$$

where B^0 is unknown and B^1 is known. B^0 is a diagonal matrix (for now we assume that). C and D are identity matrix.