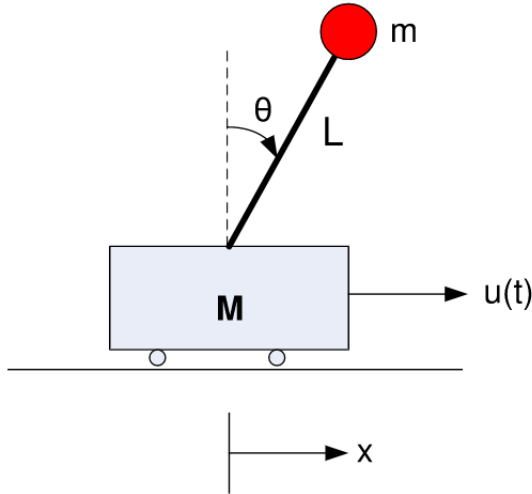


Controllability and Observability

1 Problem Statement



Consider a Cart Pendulum system. It is a horizontally moving cart with an inverted pendulum attached to it on the top. The following is the state space representation of the system:

State Equation:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & -1.96 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 5.88 & 0 \end{bmatrix} \begin{bmatrix} x \\ \dot{x} \\ \theta \\ \dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 \\ 0.2 \\ 0 \\ -0.1 \end{bmatrix} V$$

Output Equation:

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

So, as you can see the A, B and C matrices of the system have been provided to you. Comment on whether the given system is controllable and or observable. You need to support your answer with a proof for your explanation.