QL1-05

BALANCE OF DOUBLE INVERTED PENDULUM

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Introduction

The inverted pendulum system is a classical problem in feedback controls. The purpose is to stabilize the pendulum in its unstable equilibrium point. The double inverted pendulum is an extension of the inverted pendulum. The goal of the double inverted pendulum is to stabilize both rods in the vertical position while maintaining a desired position on the track.

Objectives

Clearly, the aim of this project is to build up a controller to balance the system. The program I chose to use is simulink. If mathematic expressions are built, a controller can be built based on them, the inverted pendulum will be balanced, and the project will successes, this is the objective of this project.
Methodology

Stage one - Mathematical Modeling

The mathematical model is a set of dynamic equations that provide an accurate description for the motion of a particular system.

\[ \begin{bmatrix} x \\ \dot{\theta}_1 \\ \dot{\theta}_2 \\ \dot{x} \\ \dot{\theta}_1 \\ \dot{\theta}_2 \end{bmatrix} \]

\[ y = \begin{bmatrix} x \\ \dot{\theta}_1 \\ \dot{\theta}_2 \end{bmatrix} \]

\[ \dot{x} = Ax + Bu \]

\[ y =Cx \]

Stage two – Data collection and program writing

After collecting the data, a Matlab program can be written.

Stage three - LQR control System block diagram
Results

Initial conditions:
Cart position, $X = 0$
Angle of rod 1, $\theta_1 = 0.05 \text{ rad}$
Angle of rod 2, $\theta_2 = -0.07 \text{ rad}$

Conclusion

The final result was the double pendulum system whose actual performance coincided with that of the theory. The LQR method was used to obtain an initial set of gain values required to stabilize the pendulum.