Lab3

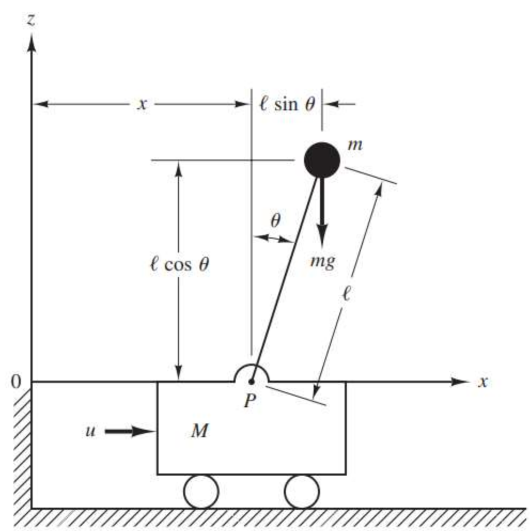
1. Introduction

In this lab, you and your partner are going to simulate an inverted-pendulum-on-cart system in MATLAB and create a 3D animation to visualize the system response. You will also need to solve for the Laplace transform of the system equation using MATLAB.

Please include the following in your lab report:

a. Statement of work distribution between you and your partner
b. A few sentences describing the aim of this lab
c. Answers to each question with step-by-step explanation
d. MATLAB code, well organized, with comments when necessary
e. One paragraph explaining the results you get, what you've learned in this lab, and any other conclusions

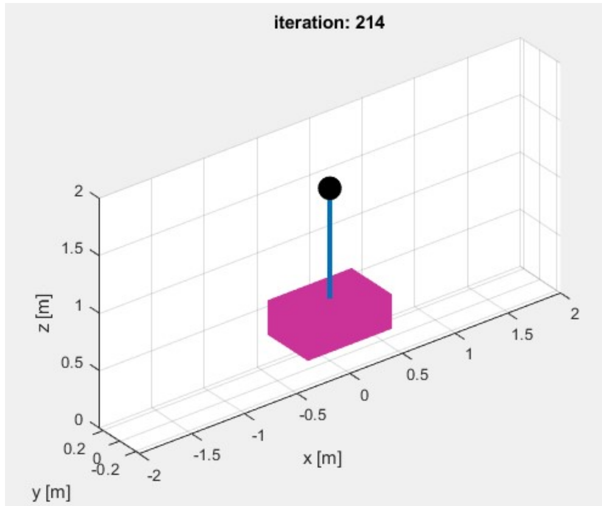
2. Simulate inverted-pendulum-on-cart system in MATLAB



a. Read through the state space derivation of an inverted-pendulum-on-cart system in Ogata's book page 69-72.

b. Create a MATLAB script "inverted-pend-cart.m", simulate the system in time-domain from scratch without using MATLAB control system toolbox. System parameters are m=0.1kg, M=1kg, L=1m, g=9.8 m/s^2. Set input u to be 0 during the entire simulation. Set initial conditions to be $[0, 0, 0, 0]^T$

c. Create a 3D animation for the system in the same MATLAB script. You can either use the provided STL file "mass1.stl" to represent the cart or draw your own cart inside MATLAB script. The pendulum can be drawn using the “line” command. The pole of the pendulum can be drawn using “plot3” command. Below is a reference of how your simulated model may look like.



d. Find the transfer function of the inverted-pendulum-on-cart system (solve for the Laplace transform of the system equation) using MATLAB (you are allowed to use the control system toolbox here). Use the pendulum titled angle θ as the system output. Report the 2 poles of the transfer function.

   Hint: create a transfer function variable “s” using “s=tf(‘s’)”. Poles can be found using the “zero” command to solve for the roots of the denominator of the transfer function.

e. Answer the following questions:
   i. Is there any limitation for the state space model presented in Ogata’s book? (Hint: does this system model suit for any system state?)
   ii. Change the initial conditions to $[0, 0.5, 0, 0]^T$, show the system response you’re getting. Is this system stable by itself?