HW Problem Set 3

EE379 Linear Control Systems

Fall 2015

Due: 10 Jan 2016

Notes

- This assignment will be submitted in LaTeX ONLY (as a report)
- No Hard Copies accepted
- You need to submit the
  - TeX File (source file of the LaTeX code)
  - Compiled PDF File
- You can use either a cloud version of LaTeX (ShareLatex, Overleaf* etc.) or an offline version (TeX, WinEdt etc.)

* I found it better than ShareLatex

Chapter 9

- Do any one of the following
  - Problem 50
  - Problem 51
  - Problem 34
- Write the solution in Latex

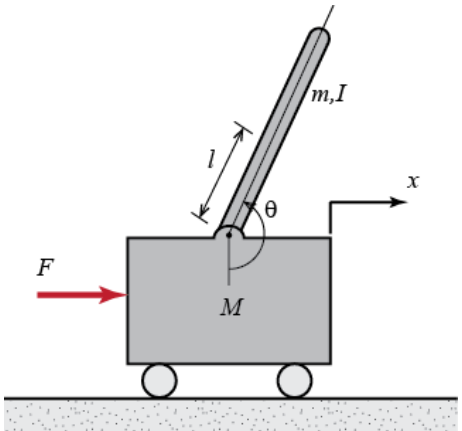
Linearization based PID Design

- Remember the inverted pendulum on the cart (in the slides)? In that problem we 'linearized' the nonlinear system about an operating point. A real-world example that relates directly to this inverted pendulum system is the attitude control of a booster rocket at takeoff.[1]
- You will need to first linearize the system
- You need to derive the transfer function between the force applied to the cart (input) and the angular position of the pendulum (output).
- After you have obtained the linearized model of the system, design a 1) PID and 2) Lead-Lag compensator such that certain design specifications (next slide) are achieved
- Here are the system parameters:
  - Mass of pendulum = max(Your scores in sessional 1/50, 0.9) (in kg)
  - Mass of the cart = Your previous semester GPA (in kg)
  - Coefficient of friction = 0.5 N/m/sec
  - Length to pendulum center of mass = Your CGPA (in m)
  - Mass moment of inertia of pendulum = 0.005 kg m^2

1. http://ctms.engin.umich.edu/CTMS/index.php?aux=Home

Linearization based PID Design (cont.)

- Design Specifications:
  - Settling time for θ of less than 7 seconds
  - Pendulum angle θ never more than 0.06 rad from the vertical
  - Steady-state error of less than 3% for θ
- Do everything in MATLAB/Simulink
- You should use the sisotool (SISO Design Toolbox) to verify your design via simulations



Resources

- You may use resources for taking help
- Highly recommended is this one: http://ctms.engin.umich.edu/CTMS/index.php?aux=Home