CprE 558 Project Proposal

Inverted Pendulum

# Group Members

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# Project Type

This is an implementation based project.

# Abstract (Project Goal)

In this project, we will be comparing the settling time, steady-state error, and peak-overshoot values for the Quanser IP02 Inverted Pendulum Cart using the same LQR controller on three different platforms: the Quanser VoltPAQ-X1 & G8-USB DAQ using Matlab/Simulink (Quanser implementation), a Xilinx Zybo board with the controller implemented through FreeRTOS (software implementation), and a Xilinx Zybo board with the controller implemented in hardware (hardware implementation).

# Approach

We will first develop a linearized model of our inverted pendulum system. This will provide a set of constant matrices that will be used in the LQR controller. Using the same constants across all three implementations, we will measure the settling time, steady-state error, and peak-overshoot of each implementation.

# Expected Outcomes

For all measured values, we expect the hardware implementation to perform the best, the software implementation to perform second best, and the Quanser implementation to perform the worst.

# References

[1] Apkarian, Lacheray, Martin (2012). Student Workbook IP02 Base Unit Experiment for Matlab/Simulink Users.

[2] Quanser (2012). User Manual IP02 Base Unit Experiment – Setup and Configuration

[3] N. Safari-Shad, “Modern Control Systems – EE4310 Lab Project #4”, University of Wisconsin-Platteville, Platteville, WI, 2017, pp.1-3

[4] P. Zhang, A. Mills, J. Zambreno and P. Jones, “The Design and Integration of a Software Configurable and Parallelized Coprocessor Architecture for LQR Control”, *Journal of Parallel and Distributed Computing (JPDC)*, 2017.