ME 560, SPRING 2003, RAHN
LAB 3: State Variable Control Design

Introduction

In this lab, you are to use your assigned ECP experiment (Torsion or Industrial Servo Trainer) in the Control Laboratory (243 Reber). The objective of this lab is to give you a chance to design and implement a digital controller using state variable control techniques.

Approach

First, based on your dynamic model of the plant, use the pole placement technique to design a full state feedback controller that provides good performance. Use the performance specifications from Lab #2. Test the response to a nonzero initial condition. Second, design an estimator with gains that provide good performance. Test the estimator performance using the previously developed state feedback controller with the control signal and output running to the estimator. Do not use the estimated states in the feedback yet. Test the initial condition response. Finally, implement estimated state feedback. Test the response to the same nonzero initial condition.

Deliverables

1. State feedback controller: Desired pole locations and feedback gains, theoretical initial condition response, and experimental initial condition response.
2. Estimator: Desired pole locations and gains, theoretical time response plot of actual and estimated output, experimental time response plot of actual and estimated output.
3. Estimated state feedback: Theoretical initial condition response and experimental initial condition response.
4. Discussion of the results.

Project Proposal

The final project should be hardware (experimental) implementation of some of the control systems developed in this class. You may use your assigned ECP equipment in the Controls Lab or other experimental facilities. Any facilities outside the Controls Laboratory, however, must be ready for control implementation (i.e. no hardware and/or software development needed). Your proposal should include a description of a specific application (e.g. control surface for an underwater vehicle, transmission drive line for an electric car, …), the physical hardware including available actuators, sensors, and real-time computer, an open loop step response of the system, a proposed control approach, and a project timeline.