University of California, Berkeley
Department of Electrical Engineering and Computer Science

EE128 Feedback Control Fall 2004

Course Description:

Three hours of lecture and three hours of laboratory per week. Analysis and synthesis of continuous and sampled-data linear feedback control systems. Advantages of feedback. Design by root locus, frequency response, and state space methods, with a comparison of techniques.

Prerequisite: EE120.


Topics Covered:

- Introduction to Control Systems
- Mathematical Modeling of Electrical and Mechanical Systems
- Block Diagram Manipulation
- State Variable Representation
- Time Domain Analysis
- PID controller
- Stability analysis of Control Systems
- Routh's stability criterion
- Root Locus Techniques
- Nyquist criteria, Gain Margins; Phase Margins
- Lead and lag compensator design
- State Variable Theory
- Coordinate transformation
- Canonical realization
- Controllability and observability
- State feedback and estimator design
- Discrete time system
- Discrete controller design by emulation
- Z-domain controller design

Course Instructor: Ping Hsu

Office: Cory 477

Phone and E-mail: (408) 924-3902, pinghsu@comcast.net

Grading: Homework: 10%, Lab: 25%, Midterm: 25%, Final: 40%
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Overview</td>
<td>Overview</td>
</tr>
</tbody>
</table>
| 2. Dynamic Models (1st week) | 2.1 Dynamics of Mechanical Systems  
2.2 Diff Equ. in State variable form  
2.6 Linearization |
| 3. Dynamic Response (2nd week) | 3.1 The Laplace transform  
3.2 Block diagram  
3.3 Response versus Pole locations  
3.4 Time-domain specification  
3.5 Effects of zeros and additional poles |
| 4. Basic Properties of Feedback (3~4th week) | 3.6 Stability, Routh stability criterion  
4.1 A case study of speed controller  
4.2 The classical three-term controller (PID)  
4.3 Steady-state Tracking and system type |
| 5. The Root Locus Design Methods (5-6th week) | 5.1 Root locus of a basic feedback system  
5.2 Guidelines for sketching a root locus  
5.3 Selected illustrative root loci  
5.4 Selecting gain from the root locus  
5.5 Dynamic compensation |
| 6. Frequency Response Design Method (7~8th week) | 6.1 Frequency response  
6.2 Stability  
6.3 The Nyquist Stability Criterion  
6.4 Stability Margins  
6.7 Compensation (lead/lag compensator) |
| Midterm |  |
| 7. State Space Design (9~11th week) | 7.1 Advantages of state space  
7.2 Analysis of the state equation  
7.3 Control law design for full state feedback  
7.5 Estimator Design  
7.6 Compensator Design |
| 8. Digital Control (12~14th week) | 8.1 Digitization  
8.2 Dynamic Analysis of discrete systems  
8.3 Design by Emulation  
8.4 Discrete Design  
8.5 State space design methods |