University Of California, Berkeley
Department of Mechanical Engineering

ME 290 Z Topics in Control, Modeling and Optimization [3 units]

(Graduate Course)

Syllabus

- ONLINE RESOURCES: Course website
- CATALOG DESCRIPTION

Advanced topics in control, modeling and optimization research with extensive illustrative applications to diverse areas in mechanical engineering systems and mechatronics. Topics will vary from year to year and will be announced at the beginning of each semester that the course is offered. Theoretical issues covered in the course include topics such as iterative learning control, control over networks, and modeling for controls. The illustrative applications will be drawn from such topics as mechatronics for improving the quality life among others.

- COURSE PREREQUISITES

ME232 and ME233

- TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

None.

- COURSE OBJECTIVES

The objective of the course is to present forefront developments in the field of control, modeling and optimization with extensive illustrative applications to diverse areas in mechanical engineering systems and mechatronics. Theoretical issues covered in the course include topics such as iterative learning control, control over networks, and modeling for controls. The illustrative applications will be drawn from such topics as manufacturing systems and mechatronics for improving the quality life among others. Topics will vary from year to year.

- TOPICS COVERED (Spring 2008)
    - Week 1: Introduction: Current trends of research in control, modeling and optimization will be introduced based on societal needs, funding trends as well as published papers at technical conferences and periodicals in the field.

- Week 2: Iterative learning control (ILC). Problem formulation and analysis of ILC via lifting. ILC and repetitive control.
- Week 3: Synergy between ILC and other control methodologies.
- Week 4: Application of ILC to robot control.
- Week 5. Application of ILC to semiconductor manufacturing.
- Week 6: Application of ILC to hard disk drives (self servo writing).
- Week 7: Sensing rich approach to the design of motion control systems: sensors for motion controls. Motivation for sensing rich approach and synergistic uses of various sensors.
- Week 8: Sensor fusion for tuning of the motion controller.
- Week 9: Kinematic Kalman Filtering for better state estimation.
- Week 10: Vision based tracking control: simultaneous use of encoder/accelerometer measurements and vision image.
- Week 11: Mechatronics to improve the quality of life of human: overview.
- Week 12: Interaction among machine, human and environment and its application to the design of electronic power steering systems and electronic bicycles.
- Week 13: Sensing and actuation for gait analysis and walking assistance for elderly and physically impaired patients.
- Week 14 and 15: Project presentations

- COURSE FORMAT
  - 3 hours of lecture
- ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES
  - Weekly homework assignments (40 %),
  - Oral presentation (10 %),
  - Final project (50 %).
- ESTIMATED TOTAL NUMBER OF REQUIRED HOURS OF STUDENT WORK PER WEEK. 10 HRS
- GRADING OPTION: LETTER GRADE
- PERSON(S) WHO PREPARED THIS DESCRIPTION: Masayoshi Tomizuka

ME 290Z Topics in Control, Modeling and Optimization   **Spring 2008**

Instructor: Masayoshi Tomizuka
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                   Office Hours: Tu, Th 1-3 PM

Lectures: Tu, Th 3:30-5:00 pm in Rm. 1165 Etcheverry Hall

Grading Scheme: Class participation   50 %
                   Final project   50 %

About the course: The objective of the course is to present forefront developments in the field of control, modeling and optimization with extensive illustrative applications to diverse areas in mechanical engineering systems and mechatronics. Theoretical issues covered in the course include topics such as iterative learning control, control over networks, and modeling for controls. The illustrative applications will be drawn from such topics as manufacturing systems and mechatronics. Topics will vary from year to year. In spring 2008, the topic is iterative learning control (ILC). We will learn various aspects and applications of ILC. To achieve the goal, your active participation in the class is critically important. You may be asked to conduct an in-depth study of some subtopics and share your findings with others in the class.

Topics to be covered (tentative):

   Iterative learning control (ILC). Problem formulation and analysis of basic ILC systems.
   Robustness of ILC
   Design approaches
   Effect of non-repetitive disturbances and stochastic noise
   ILC and repetitive control.
   Phase Locked Loop
   Iterative Feedback Tuning
   Synergy between ILC and other control methodologies
   Learning specific trajectory, a specific class of trajectories or a general class of trajectories.
   Application of ILC to robot control.
   Application of ILC to semiconductor manufacturing.
   Application of ILC to hard disk drives (self servo writing)