University of California, Berkeley
Department of Mechanical Engineering
Department of Electrical Engineering and Computer Sciences

ME C231B: Experiential Advanced Control Design II (3 units)
EECS C220C: Experiential Advanced Control Design II (3 units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

Experience-based learning in the design, analysis and verification of automatic control systems. The course emphasizes the use of computer-aided design techniques through case studies and design tasks. The student will master skills needed to apply advanced model-based control analysis, design and estimation to a variety of industrial applications. The role of these specific design methodologies within the larger endeavor of control design is also addressed.

COURSE PREREQUISITES

ME C231A/EECS C220B and either ME C232/EECS C220A or EECS 221A

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Numerous textbooks recommended (Khalil, Skogestad & Postlethwaite, Astrom, Zhou, …); course reader made up of relevant journal articles; course lecture notes; slides from lectures.

COURSE OBJECTIVES

Experience-based learning in the design, analysis and verification of automatic control systems. The course emphasizes the use of computer-aided design techniques through case studies and design tasks.

DESIRED COURSE OUTCOMES

The student will master skills needed to apply advanced model-based control analysis, design and estimation to a variety of industrial applications. In particular, the participant will be exposed to and develop expertise in six key control design technologies. The role of these specific design methodologies within the larger endeavor of control design is also addressed.

TOPICS COVERED

1. The process of Control Design (w/ invited Industry partners): objectives, modeling, variable scaling, control structure, synthesis, testing. (1.5 weeks)
2. Design Formalisms: study 6 design methods, and gain practical and relevant experience using design software on practical examples:

a. (2 weeks) Nonlinear Control: feedback linearization and sliding mode control;
b. (2 weeks) Estimation and Kalman Filtering: optimal state estimation in noisy systems, application to a wide variety of estimation problems, including fault detection and multiple-model estimation;
c. (2 weeks) Robust Control: uncertainty models, robustness analysis including structured singular value and integral quadratic constraints, robust multivariable design;
d. (2 weeks) Adaptive Control: applications in which adaptive control may be useful, fundamental adaptive control architectures, parameter adaptation algorithms and basic adaptive control techniques, pitfalls of adaptation.
e. (1.5 weeks) Iterative Learning Control (ILC) and repetitive control: applications in which iterative control and/or repetitive control may be useful, basic iterative and repetitive control synthesis and analysis techniques.
f. (2 weeks) Linear Parameter Varying (LPV) control: LPV analysis and synthesis, quasi-LPV modeling of nonlinear systems, application to gain-scheduling.

3. (1 week) Case-study examples of the full design process

CLASS/LABORATORY SCHEDULE

3 hours lecture per week, 2 hour computer practice lab

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

While the focus of the course is several key control design technologies, the larger task of control design is also studied. This includes strategies to define performance metrics, develop control-oriented process models, characterize sensor and actuator requirements, assess appropriate control structure, create high-fidelity simulation closed-loop environment, and design a validation plan to assess the controlled system performance.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

40% - Homework
40% - Term project
20% - Final Exam

PERSON(S) WHO PREPARED THIS DESCRIPTION

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ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): Experiental Cntr II
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Borrelli, Hedrick, Horowitz, Packard, Poolla, Tomizuka
DURATION OF COURSE: 14 weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 12
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: EECS C220B