Advanced Control Engineering

Special Subjects
Elective 2 credit

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1. Course Description

Since the industrial revolution, control theory and engineering have been developed to operate mechanical, electrical, or communication systems accurately and automatically. The classical control theory, mainly for single-input single-output systems, was matured around 1960. After that, "modern control theory" using state-feedback, the main contents of the course, has been developed for large-scale and/or complicated systems.
This course consists of lectures in the classroom with exercises dealing with practical problems, and laboratory work with MATLAB.
In this course, students are expected to achieve the knowledge and technical methods with respect to DP1.

2. Course Objectives

The first objective is to understand PID control technology, which is the leading method in classical control, and to design and adjust PID controllers.
The second objective is to understand the concept of state-feedback control technology and to design and adjust pole-placement control and optimal control. They are the leading methods in modern control.

3. Grading Policy

Homework: 20%, Mid-term exam: 40%, Final exam: 40%

4. Textbook and Reference

Textbook
There is no specific textbook. The necessary materials will be distributed for each lecture.
Reference
川田 昌克　MATLAB/Simulinkによるわかりやすい制御工学　森北出版
ISBN 978-4627917217
佐藤 和也,平元 和彦,平田研二　はじめての制御工学 改訂第2版　講談社
ISBN-13: 978-4065137475
川田 昌克　MATLAB／Simulinkによる現代制御入門　森北出版
ISBN-13 : 978-4627920415
佐藤和也、下本陽一、熊澤良典　はじめての現代制御理論　講談社
ISBN-13 : 978-4061565081
木村 英紀
　制御工学の考え方　講談社ブルーバックス
ISBN-13: 978-4062573962

5. Requirements(Assignments)

This course is the extension of classical single-input, single-output control theory and engineering lectured in undergraduate course. Students are required to have the basic understanding on these fields.
Students are required to spend at least 30 hours for preparation study, review, and reports to assignments and to laboratory works.

6. Note

The concepts and principles of modern control theory and engineering are strongly related to systems engineering, especially to investigation or optimization of large/complicated systems.

7. Schedule

[1] Introduction to systems control: feedback control, classical and modern control
[2] Review of basic control engineering 1:
Differential equation and Laplace transformation
[3] Review of basic control engineering 2:
Transfer functions
[4] System responses and stability
[5] PID control
[6] State equation 1:
State space, derivation of state equation
[7] State equation 2:
Characteristic equation and stability, controllability and observability
[8] Mid-term exam
[9] Pole placement
[10] State observer
[11] Optimal regulator
[12] Optimal servo system with the observer
[13] Optimal servo system for optimal regulator
[14] Laboratory work with MATLAB
[15] Review