

Control Engineering with Information Technology

Special Subjects
Elective 2 credit

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1. Course Description

Control technology is now widely applied to many fields of modern world. It is getting more and more important for scientists and engineers to understand control theory and technology.

On the other hand, the progress of information technology makes it easy to design and to simulate control systems.

In this course, students will firstly install a free computer software Scilab/Scicos in their PC for numerical analysis and simulation. Then, they will study PID control, state feedback control, optimal control and state observer by using Scilab/Scicos.

Students are expected to acquire the knowledge and techniques related to DP1 and DP3 of the graduate school.

2. Course Objectives

The first objective is for students to learn and understand the principles and the applications of control engineering based on modern control theory, which makes it possible to overcome the difficulties which arise when classical control technologies such as PID control are applied to complicated and/or large-scaled systems. Advanced control engineering has become more important because social, industrial and mechanical systems of our age are so complicated and/or sophisticated that they need to be properly and accurately controlled without a great deal of human intervention.

The second objective is to master a free software 'Scilab/Scicos' for numerical calculations, controller designs and control simulations.

3. Grading Policy

Grading policy is based on assignment reports (30%), and on final examination at the campus (70%). The report is sent back to the student with comments from the teacher.

4. Textbook and Reference

Textbook

H. Hashimoto, C. Ishii, et al. (橋本 洋志, 石井 千春, 他) Basics of systems control (Scilabで学ぶシステム制御の基礎) Ohm publishing Co. ISBN978-4-274-20388-6 (オーム社)

H. Hashimoto, C. Ishii (橋本 洋志, 石井 千春) Basics of Simulation with Scilab/Scicos, (SCilab/Scicosで学ぶシミュレーションの基礎) Ohm publishing Co. ISBN978-4-274-20487-6 (オーム社)

Japan Society of Mechanical Engineers (edited) (日本機械学会 編) Control engineering practices (演習制御工学) Japan Society of Mechanical Engineers, ISBN978-4-88898-114-9 (日本機械学会)

Reference

none

5. Requirements(Assignments)

Students should install Scilab/Scicos (free software) in a Windows PC.

The course requires basic knowledge and understanding on classical control theory and engineering. It also requires basic understanding of mathematics, especially on differentials, integrals, complex numbers, differential equations, and linear algebra (vectors and matrices).

Students are required to spend at least 30 hours for preparation study, review, and reports to assignments.

6. Note

The principles and techniques studied in this course would be helpful in many fields of science and technology.

7. Schedule

- [1] Introduction to systems control: feedback control, classical and modern control
- [2] Review of basic control engineering: Laplace transformation, differential equations and transfer functions
- [3] Introduction to Scilab/Scicos
- [4] System responses in the time domain
- [5] Stability of the system, PID control
- [6] Mastering Scicos, PID control simulation
- [7] Exercises on PID control
- [8] State equation 1: state space, derivation of state equation
- [9] State equation 2: characteristic equation and stability, controllability and observability
- [10] Pole placement and state observer
- [11] Optimal regulator (LQ optimal control), cost function, weighing matrices
- [12] Optimal servo system 1: augmented system, disturbance suppression, robustness
- [13] Optimal servo system 2, simulation of optimal regulator with the observer
- [14] Exercises on optimal servo system
- [15] Review and exercises