

MECH 523

INTELLIGENT CONTROL

3 Credits, Second Semester 2007/2008

Meeting Time & Place

Tuesdays and Thursdays - 5:00 to 6:30 p.m.
Woodward IRC Room G57

Instructor

Dr. Clarence de Silva
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Prerequisites

- For engineering graduate students: Motivation
- For undergraduate students: A course in feedback controls + consent of the instructor.

Introduction

An intelligent system may possess capabilities such as perception, learning, reasoning, and making inferences or decisions from incomplete information. This requires a knowledge system in which the representation and processing of knowledge are central functions. Approximation is a soft concept, and the capability to approximate for the purposes of comparison, pattern recognition, reasoning, and decision making is a manifestation of intelligence. This introductory course presents the principles of soft computing and their application in intelligent control. Soft computing is an important branch of computational intelligence where fuzzy logic, probability theory, neural networks, and genetic algorithms are synergistically used to mimic reasoning and decision making of a human. The use of fuzzy logic is emphasized in the course. However, the basics of neural networks and evolutionary computing (particularly genetic algorithms) are covered as well. No prior knowledge of the subject is assumed. First, some traditional control techniques are introduced and contrasted with intelligent control. Since the representation and processing of knowledge are the basis of intelligent and knowledge-based control, several approaches for this are given. Fuzzy logic is presented as one such approach of representing and processing knowledge. Next, system control using fuzzy logic is introduced, within the framework of Fuzzy Logic Control. Several analytical concepts related to fuzzy sets and fuzzy logic, including knowledge-based decision making, control-system tuning and intelligent hierarchical control, are discussed. Several types of neural networks, their theory, and application in nonlinear systems are discussed. The main principles of genetic algorithms are introduced. The application of genetic algorithms in system optimization is discussed.

Textbook

Karray, F. O. and de Silva, C. W., *Soft Computing and Intelligent Systems Design—Theory, Tools, and Applications* (Addison Wesley, 2004), ISBN 0-321-11617-8.

Course Plan

<u>Week</u>	<u>Starts</u>	<u>Topic</u>	<u>Read</u>
1	Jan. 08	Introduction	Chapter 1
2	Jan. 15	Conventional and Intelligent Control	Chapter 1
3	Jan. 22	Knowledge Representation and Processing	Chapter 1
4	Jan. 29	Soft Computing	Chapter 1
5	Feb. 05	Fuzzy Sets and Fuzzy Logic	Chapter 2
6	Feb. 12	Analytical Topics of Fuzzy Logic	Chapter 2
	Project proposals due		
7	Feb. 26	Fuzzy Logic Control	Chapter 3
8	Mar. 04	Control System Tuning	Chapter 9
9	Mar. 11	Intelligent Hierarchical Control	Chapter 9
10	Mar. 18	Fundamentals of Neural Networks	Chapter 4
	Exam on Mar. 18		
11	Mar. 25	Neural Networks and Applications	Chapter 5
12	April 01	Evolutionary Computing	Chapter 8
13	April 08	Project presentations	

Note: Final Take-Home Exam/Project Report due in MECH office on April 11th.

Grade Composition

Intermediate exam	=	30%
Project proposal	=	10%
Attendance/Participation	=	10%
Final Take-Home Exam/Project	=	<u>50%</u>
Total	=	100%
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