



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Adaptive and robust control [S2AiR2-ISA>SAiO]

Course

Field of study

Automatic Control and Robotics

Year/Semester

1/2

Area of study (specialization)

Intelligent Control Systems

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

30

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

[K2_W01] [K2_W02] [K2_W03] K2_W08] [K2_U07] [K2_K01]

Course objective

The aim of the subject is to present basic adaptive control methods and robust control methodology to students. Mainly, discrete-time control systems are discussed from adaptation viewpoint, and continuous-time from robustness perspective.

Course-related learning outcomes

[K2_W7]

[K2_W9]

[K2_U10]

[K2_U27]

[K2_K1]

[K2_K5]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

LECTURE:

Written exam.

LABORATORY EXERCISES:

Laboratory exercises: verification of practical abilities, writing reports, the laboratories end with a group task (working in teams).

Pass from 50% of the maximum number of the points.

Programme content

Review of adaptive control methods for deterministic and stochastic systems. Closed-loop identification. Direct and indirect control methods. Gain-scheduling control. Idea of robustness, uncertainty, including uncertainty to block diagrams, design of a robust controller.

Course topics

LECTURES

Models of processes. Adaptive control methods. Applications of adaptive control. Model reference adaptive control. MIT and Lyapunov methods. Adaptive controllers for deterministic plants: pole-placement control, model reference control. Indirect adaptive control. Direct self-tuning controllers. Known disturbances. Gain scheduling. Minimum-variance control. Generalization of self-tuning controllers. Predictive control. Auto-tuning of PIDs. Robust control idea. Optimal loop shaping. Optimal disturbance rejection. Robust stability. Uncertainty. Uncertainty in block diagrams. Robust stability tests. Nominal performance. Robust performance. Small-gain theorem. H_∞ control problem. Design of robust controllers in Matlab.

LABORATORY EXERCISES

Computer simulation in MATLAB/SIMULINK of basic adaptive and robust control algorithms, using recursive estimation methods. Multimedia slideshows accompanied by a discussion of solutions in selected adaptive control systems. Presentation of an adaptive control system using a laboratory stand (hardware in the loop control). Design of an adaptive and optimal control system with a full report.

Teaching methods

LECTURES:

PDF slides (figures, photos), with additional information written on the blackboard, lectures accompanied by self-studying handouts via eKursy, theory presented with reference to current knowledge of students and to practical problems, new subjects preceded by recalling subjects connected or known from other lectures.

LABORATORY EXERCISES:

Sample problems solved on the blackboard; commented solutions of the solved problems by the tutor and discussing solutions; numerical experiments.

Bibliography

Podstawowa

[1] Horla D., Sterowanie adaptacyjne, Ćwiczenia laboratoryjne, wyd. 3, Wyd. Politechniki Poznańskiej, Poznań 2010

[2] Królikowski A., Sterowanie adaptacyjne z ograniczeniami sygnału sterującego, Poznań, Wyd. Politechniki Poznańskiej, 2004.

[3] Koziański W., Projektowanie regulatorów: wybrane metody klasyczne i optymalizacyjne, Oficyna Wydawnicza Politechniki Warszawskiej, 2004

Uzupełniająca:

[1] Horla D., Adaptive Predictive Controller for a Servo Drive - Actuator/Sensor Failure Study Experiments, 14th International Conference on Informatics in Control, Automation and Robotics ICINCO, Madrid, Spain, 2017, s. 551-558

[2] Horla D., C-code Implementation of an Adaptive Real-time GPC Velocity Controller for a Servo Drive, 17th International Conference on Mechatronics - Mechatronika (ME), Prague, Czech Republic, 2016, s. 139-145

[3] Horla D., Minimum Variance Adaptive Control of A Servo Drive with Unknown Structure and Parameters, Asian Journal of Control, 2013, vol. 15, no. 1, s. 120-131

[4] Horla D., Robust Performance of Sampled-Data Adaptive Control of a Servo Drive. From Simulation to

Experimental Results, Journal of Automation, Mobile Robotics & Intelligent Systems, 2015, vol. 9, no. 2, s. 3-8

[5] Horla D., Simulation vs. experimental results of pole-placement controller with full adaptation, 2013 International Conference on Systems, Control and Informatics, 2013, Venice, Italy, s. 27-33

[6] Niederliński A., Mościński J., Ogonowski Z., Regulacja adaptacyjna, Warszawa WNT, 1995

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	38	1,50