POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Adaptive and robust control [N2AiR1-ISA>SAiO]

Course

Field of study	Year/Semester
Automatic Control and Robotics	1/2
Area of study (specialization)	Profile of study
Intelligent Control Systems	general academic
Level of study	Course offered in
second-cycle	Polish
Form of study	Requirements
part-time	compulsory

Number of hours

Lecture	Laboratory classes	Other
20	20	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

4,00

Coordinators	Lecturers
prof. dr hab. inż. Dariusz Horla dariusz.horla@put.poznan.pl	

Prerequisites

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

Course objective

The purpose of the course is to familiarize students with the basic methods and algorithms of adaptive control and the theory and methodology of robust control. Discrete methods of adaptive control and continuous methods of robust control are mainly discussed.

Course-related learning outcomes

Knowledge
[K2_W7]
[K2_W9]
Skills
[K2_U10]
[K2_U27]
Social competences
[K2_K1]

[K2_K5]

Methods for verifying learning outcomes and assessment criteria
Learning outcomes presented above are verified as follows:

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).

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_inf control problem. Design of robust controllers in Matlab.
LABORATORY EXERCISES
Computer simulation in MATLAB/SIMULINK of basic adaptive and robus 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
Basic
[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] Koziński W., Projektowanie regulatorów: wybrane metody klasyczne i optymalizacyjne, Oficyna Wydawnicza Politechniki Warszawskiej, 2004a
Additional
[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	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50