COURSE DESCRIPTION CARD - SYLLABUS

Course name

Predictive control

Course

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

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Faculty of Control, Robotics and Electrical Engineering

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Responsible for the course/lecturer:

Prerequisites

Knows and understands to a greater extent selected areas of mathematics [K2_W01 (P7S_WG)]

Has advanced and deepened knowledge of methods of analysis and design of control systems [K2_W02 (P7S_WG)]

Has ordered and theoretically founded detailed knowledge in the design and analysis of optimal systems [K2_W03 (P7S_WG)]

Has an ordered and deepened knowledge of modeling and identification of linear and nonlinear systems [K2_W08 (P7S_WG)] Can construct an algorithm for solving a complex and unusual engineering task and a simple research problem and implement, test and run it in a selected programming environment for selected operating systems [K2_U07 (P7S_UW)] It is ready to critically evaluate the received content. He understands the need and knows the possibilities of continuous training - improving professional, personal and social competences, can inspire and organize the learning process of other people [K2_K01 (P7S_KK)]

Course objective

The aim of the course is to familiarize students with predictive control of nonlinear systems. The method of controlling dynamic systems is discussed, which consists in the cyclical solving of the optimal control task.

Course-related learning outcomes

Knowledge

Student:

- knows and understands to a greater extent selected areas of mathematics; has extended and deepened knowledge necessary to formulate and solve complex tasks in the field of control theory, optimization, modeling, identification and signal processing (K2_W1),

- has advanced and in-depth knowledge of methods of analysis and design of control systems (K2_W7), has ordered, theoretically founded, detailed knowledge in the field of designing and analyzing optimal systems (K2_W8),

- has an organized and in-depth knowledge of control systems and control and measurement systems (K2_W11),

- has knowledge of development trends and the most important new achievements in the field of automation and robotics and related scientific disciplines (K2_W12).

- has detailed knowledge related to control and measurement systems - (K2_W11)

Skills

Student:

- can critically use literature information, databases and other sources in Polish and a foreign language (K2_U1),

- is able to simulate and analyze the operation of complex automation systems as well as plan and carry out experimental verification (K2_U9),

- can designate models of simple systems and processes, and use them for the purposes of analysis and design of automation and robotics systems (K2_U10),

- can formulate and verify (simulation or experimentally) hypotheses related to engineering tasks and simple research problems in the field of automation and robotics (K2_U15),

- can make a critical analysis of the operation of control systems and robotics systems; also has the ability to select automation systems with the use of programmable controllers (K2_U19),

- can critically assess and select appropriate methods and tools to solve a task in the field of automation and robotics; can use innovative and unconventional tools in the field of automation and robotics (K2_U22).

Social competences

Student:

- is aware of the responsibility for his/her own work and is ready to follow the rules of teamwork and take responsibility for the tasks performed together; he/she is able to lead a team, set objectives and determine priorities leading to the accomplishment of the task (K2_K3),

- is aware of the necessity to have a professional approach to technical issues, to be scrupulously familiar with documentation and environmental conditions in which devices and their components may operate (K2_K4).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written exam in the field of predictive control (checking theoretical knowledge).

Laboratory: end-of-work reports after each topic as a test of practical skills in the use of the predictive control algorithm.

Programme content

Lecture: Basic reminder of SISO and MIMO control structures, classic PID controller and anti-windup filter. Presentation of what predictive control is, why it is used, discussion of potential disadvantages and principles of operation, considering constraints, comparing to classical stress control, predictive control with a model in the form of state equations, nonlinear predictive control, examples, presentation of practical applications and presentation of products containing MPC solutions.

Laboratory: Computer simulations in the MATLAB / SIMULINK environment, basics related to the predictive control algorithm, multimedia presentations with solution consultations.

Teaching methods

1. Lectures: multimedia presentation, presentation illustrated with examples presented on black board, solving tasks

2. Labs: solving tasks, practical exercises, experiments, teamwork, multimedia presentation, instructions for exercises, discussion of project topics.

Bibliography

Basic

1.Camacho E.F., Bordons C. (2004). Model Predictive Control. Springer-Verlag, London Limited.

2. S.J., Badgwell T.A. (2003). A survey of industrial model predictive control technology. Control Engineering Practice 11 (2003) 733-764.

3. Tatjewski P. (2002). Sterowanie zaawansowane obiektów przemysłowych, Struktury i algorytmy. Akademicka Oficyna Wydawnicza EXIT, Warszawa

4. Maciejowski J.M. (2002). Predictive Control with Constraints. Prentice Hall, Pearson Education Ltd. Harlowe, England.

5. Agachi P.S., Nagy Z.K., Cristea M.V., Imre-Lucaci A. (2006). Model Based Control. Case Studies in Process Engineering. Wiley-VCH Verlag.

Additional

1. Re L., Allgöwer F., Glielmo L., Guardiola C., Kolmanovsky I. (2010). Automotive Model Predictive Control. Models, Methods and Applications. Springer-Verlag, London Limited.

2.Holkar K.S., Waghmare L.M. (2010). An Overview of Model Predictive Control. International Journal of Control and Automation, Vol. 3, No. 4, pp. 47-63.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	20	1,0

[1] delete or add other activities as appropriate