GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Implementation of advanced control techniques, PG_00063187		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Katedra Inteligentnych Systemów Sterowania i Wspomagania Decyzji -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jarosław Tarnawski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	10.0	0.0	15.0	0.0	0.0	25

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	25	10.0	40.0	75

Subject objectives

Knowledge of online estimation methods. Knowledge of adaptive control methods. Knowledge of linear predictive control methods. Knowledge of adaptive-predictive control methods with updating knowledge about the model. Knowledge of predictive control methods with limitations. Knowledge of nonlinear predictive control methods. Advanced ability to implement filtration, estimation and control algorithms on the PLC platform. Ability to verify developed control algorithms. Optimality issues and including control costs in the criterion.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_U08	Student has the ability to prepare and develop a scientist's skills.	[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
K7_W07	The student has knowledge of securing and authorizing access to industrial control systems	[SW3] Assessment of knowledge contained in written work and projects
K7_U09	The student is able to perform economic analysis for automation tasks	[SU2] Assessment of ability to analyse information
K7_K05	The student is able to conduct the research process in an entrepreneurial manner	[SK5] Assessment of ability to solve problems that arise in practice
K7_W10	The student has in-depth knowledge of the electric drive.	[SW1] Assessment of factual knowledge
K7_K02	The student is able to play a leadership and subordinate role when preparing a scientific publication.	[SK1] Assessment of group work skills

Subject contents

Deepening knowledge about methods of implementing control systems in target industrial platforms. Advanced programming on the PLC platform. In-depth knowledge of methods for porting code from Matlab to PLC using PLC Coder. Principles of implementing advanced filtering, estimation and data control algorithms by differential equations on the PLC platform. Configuration and programming on the DCS platform. Creating hybrid DCS-PLC installations. Modeling for control purposes. Online estimation methods for updating knowledge about the control object. Adaptive control methods, methods of programmatic gain changes, indirect and direct methods, MRAC. Model-based control methods. Predictive control methods: linear, non-linear and with constraints. Multidimensional control issues. Methods of implementing a control system with an external optimizer. Verification of the implemented algorithms in the conditions of a software loop and a hardware loop with a simulated control object. Verification of control methods for real objects. Issues of evidence for the stability of the control system.

Prerequisites and co-requisites		
Assessment methods and criteria		

Subject passing criteria	Passing threshold	Percentage of the final grade
Project	50.0%	50.0%
Lecture	50.0%	50.0%

Recommended reading	Basic literature	Grega, W., Metody i algorytmy sterowania cyfrowego w układach scentralizowanych i rozproszonych, Uczelniane Wydawnictwa Naukowo-Dydaktyczne Akademii Górniczo-Hutniczej, Wydawnictwa AGH, 2004 Tatjewski P., Sterowanie zaawansowane obiektów przemysłowych struktury i algorytmy, Akademicka Oficyna Wydawnicza Exit, 2002 Kwiecień, R., Komputerowe systemy automatyki przemysłowej, Helion, 2013 A. Niederlinski, J. Moscinski, and Z. Ogonowski, Regulacja Adaptacyjna. Warsaw, Poland: Wydawnictwo Naukowe PWN (in Polish), 1995. Soderstrom T., Stoica P., Identyfikacja systemów, Wydawnictwo Naukowe PWN, 1997 T. L. Blevins, G. K. McMillan, W. K. Wojsznis, and M. W. Brown, Advanced Control Unleashed: Plant Performance Management for Optimum Benefit. Research Triangle Park, NC, USA: ISA, 2002 Jaimes E., ADVANCED CONTROL SYSTEMS, KS OmniScriptum Publishing, 2021
	Supplementary literature	J. D. Hoffman, J. D. Hoffman, and S. Frankel, Numerical Methods for Engineers and Scientists, 2nd ed. Boca Raton, FL, USA: CRC Press, 2017, N. J. Higham, Accuracy and Stability of Numerical Algorithms, 2nd ed. Philadelphia, PA, USA: SIAM, 2002. K. D. Dorfman and P. Daoutidis, Numerical Methods with Chemical Engineering Applications, 1st ed. Cambridge, U.K: Cambridge Univ. Press,2017. E. F. Camacho and C. B. Alba, Model Predictive Control. London, U.K.: Springer, 2013. J. A. Rossiter, A First Course in Predictive Control, 2nd ed. Boca Raton, FL, USA: Taylor & Francis, 2018. G. Tao, Adaptive Control Design and Analysis, 1st ed. Hoboken, NJ, Wiley, 2003.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	A theoretical study on the assessment of the suitability and implementation requirements of the adaptive and predictive control methods discussed in the course. Synthesis of an adaptive and predictive control system using a PLC and a laboratory facility. Synthesis of the control system with an external optimizer.	
Work placement	Not applicable	