

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00000BI-0150	Name of the course	Polish	Sterowanie procesami powtarzalnymi w energoelektronice i serwonapędach		
			English	Repetitive control in power electronics and servo drives		
Type of the course	specialized					
Course coordinator	Bartłomiej Ufnalski, Ph.D., D.Sc.		Course teacher	Bartłomiej Ufnalski, Ph.D., D.Sc.		
Implementing unit	Faculty of Electrical Engineering	Scientific discipline/disciplines*	AEEITK, IŚGiE			
Level of education	Doctoral studies	Semester	winter/spring or fall			
Language of the course	English					
Type of assessment	formative	Number of hours in a semester	15	ECTS credits	1	
Minimum number of participants	10	Maximum number of participants	12	Available for students (BSc, MSc)	No	
Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar/Workshop
Number of hours	in a week	-	-	-	-	2
	in a semester	-	-	-	-	15

* does not apply to the Researcher's Workshop

1. Prerequisites

Participants are familiar with the fundamentals of control systems in power electronics and drives. Prior programming experience and knowledge of MATLAB/Simulink are assumed. We are going to use also Plecs from Plexim.

2. Course objectives

The main objective is to get familiar with selected problems within the field of repetitive control in power electronics and drives.

3. Course content (separate for each type of class)

Lecture

-

Laboratory/Workshop

Workshop outline:

- 1) measurement noise and delays in digital control systems,
- 2) internal model principle:
 - a) reference tracking,
 - b) disturbance rejection,
- 3) continuous vs. batch repetitive processes,
- 4) models of signals:
 - a) discretization,
 - b) frequency matching (pre-warping),
 - c) fractional delay filter,
 - d) zero-phase filter,
- 5) reference feedforward and disturbance feedforward,
- 6) limitations of the Naslin polynomial tuning method and common errors,
- 7) global optimization-based tuning methods.

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Knowledge of selected concepts in repetitive control algorithms	SD_W3	active participation during classes
K02			
K03			
Skills			
S01	Ability to model and design a repetitive control system	SD_U1	active participation during classes
S02	Ability to perform a critical assessment of obtained results	SD_U2	active participation during classes
Social competences			
SC01	Ability to critically assess solutions proposed in the topical literature	SD_K1	active participation during classes

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Based on active participation during workshops and active problem solving at home, that includes researching existing algorithms, assessing them critically, developing your own ones, and testing them in a simulational environment.

6. Literature
<p><u>Primary references:</u></p> <p>[1] https://ieeexplore.ieee.org/document/9861410 (Robust Tuning of Multiresonant Current Controllers for Grid-Tied Converters and Erroneous Use of the Naslin Polynomial Method)</p> <p>[2] https://www.isep.pw.edu.pl/index.php/zne/content/download/1280/8127/file/PhD_Thesis_Stras.pdf (Andrzej Straś: Repetitive Control for a Three-Phase Grid-Tied Converter Under Distorted Grid Voltage Conditions, Ph.D. thesis, 2022)</p> <p><u>Secondary references:</u></p> <p>[1] https://www.mathworks.com/matlabcentral/profile/authors/2128309 (my space on Matlab Central)</p>

7. Ph.D. student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	15
2	Hours of consultations with the academic teacher, exams, tests, etc.	-
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	15

4	Amount of time devoted to the preparation for exams, tests, assessments	-
Total number of hours		30
ECTS credits		1

** 1 ECTS = 25-30 hours of the Ph.D. student's work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring the direct participation of academic teachers	
Number of ECTS credits earned by a student in a practical course	