



Subject card

Subject name and code	Kalman Filters and Stochastic Control, PG_00064537						
Field of study	Kalman Filters and Stochastic Control						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group		Optional subject group Specialty subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		English		
Semester of study	1		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Automatic Control -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Artur Gańcza				
	Teachers		dr inż. Artur Gańcza				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	0.0	30
	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	30		4.0		16.0	50
Subject objectives	Introducing design methods for regulation systems working in random conditions.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W01] knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study		Studenci rozumieją zasadę działania estymacji minimalnowariancyjnej, rozumieją sposób działania filtru Kalmana oraz jego wybranych modyfikacji. Studenci rozumieją działanie sterowania minimalnowariancyjnego oraz znają właściwości takich sterowników. Studenci rozumieją jak wnioskowanie Bayesowskie może zostać wykorzystane w łączeniu efektów działania różnych algorytmów.		[SW1] Ocena wiedzy faktograficznej [SW2] Ocena wiedzy zawartej w prezentacji		
	[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study		Students know basic kinds of random processes and Markow's decision problems. Students understand the principle of Bayesian reasoning.		[SW1] Ocena wiedzy faktograficznej [SW2] Ocena wiedzy zawartej w prezentacji		

Subject contents	Course content – lecture		
	1. Principles of minimum variance (MV) control 2. MV regulators for ARMAX systems 3. Stability of MV regulators 4. Diophantine equations and their solutions 5. MV tracking of a reference signal 6. Limitations and drawbacks of MV control 7. Moving average (MA) control 8. Linear quadratic (LQ) control principles 9. Design of LQ regulators 10. Principles of minimum variance estimation 11. Introduction to Kalman filtering conditional densities of Gaussian variables 12. Prediction, filtration and smoothing of stochastic signals 13. Kalman predictor and Kalman filter 14. Properties of Kalman filter 15. Stationary Kalman filter Wiener filter 16. Kalman filter as an optimal state observer 17. Application of Kalman filter to airplane tracking 18. Numerical safeguards used in Kalman filtering 19. Extended Kalman filter (EKF) 20. Application of EKF to localization of an autonomous guided vehicle 21. LQ regulators in state space 22. Separation theorem 23. Robustness of LQ regulators 24. Markov chains 25. Multiple models estimation methods		
	Course content – project		
	1. Kalman filter in state estimation of a stationary object. 2. Kalman filter in state estimation of a stationary nonlinear object. 3. Combining estimation results of multiple Kalman filters.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	52.0%	100.0%
Recommended reading	Basic literature	B. D. O. Anderson & Moore J. B., "Optimal Filtering", Dover Publications, 2005	
	Supplementary literature	Blackman S. & Poppoli R., "Design and Analysis of Modern Tracking Systems", Artech House, 1999	
	eResources addresses		
Example issues/ example questions/ tasks being completed			
Practical activities within the subject	Not applicable		

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