GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Echolocation Methods, PG_00048434
Field of study	Automatic Control, Cybernetics and Robotics

Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Optional 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	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment

Conducting unit	Department of Marine Electronic Systems -> Faculty of Electronics, Telecommunications and Informatics

Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Roman Salamon
	Teachers	prof. dr hab. inż. Roman Salamon

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	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	The aim of the course is to acquaint students with the principle of operation, construction and parameters of radars, sonars and aeroacoustic systems used in automatic control and give them knowledge of methods and techniques of generation, emission, detection and imaging.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W21] Knows and understands, to an advanced extent, methods and techniques of design and operation of automatic control systems, control and robotics systems, as well as the use of computers in the control and monitoring of dynamic objects	The student learns the methods of digital signal processing in echolocation systems. He evaluates the possibilities of their implementation in computers and signal processors.	[SW1] Assessment of factual knowledge
	[K7_U21] can individually carry out an in-depth analysis of controlling, diagnostics and signal processing problems; and, to an advanced extent, is able to individually design, tune and operate automatic regulation, control and robotics systems; and use computers to control and monitor dynamic systems	The student learns the methods of measuring the spatial location of moving objects and their speed. He can use them in control systems	[SU2] Assessment of ability to analyse information
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	He selects solutions of echolocation systems appropriate to tasks met in automatic control and robotics. He analyzes technical solutions of system for their realisability and costs.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum.	Student describes the principles of work, functional diagrams and signal processing algorithms of echolocation systems used in automatic control and robotics. He defines the technical and operational parameters of echolocation systems and analyzes relationships occurring between them.	[SW1] Assessment of factual knowledge

Subject contents	
	1. Course organization, requirements, consultations 2. General principles of echolocation systems functioning 3. Principles of microwave echolocation systems 4. Principles of microwave echolocation systems 5. Principles of laser echolocation systems 6. Application of echolocation systems in automatics and robotics 7. Functional model of echolocation systems 8. Range, angular and range resolutions, time of space sector scanning 9. Space scanning techniques 10. Single- and multi-beam systems 11. Sounding signals, spectra and autocorrelation functions 12. Ambiguity function 13. Antennas of microwave echolocation systems 14. Transducers and antennas of acoustic echolocation systems 15. Transmitters and detectors of laser echolocation systems 16. Directivity patterns 17. Directivity index 18. Source level 19. General features of echolocation systems channels 20. Space distribution of wave propagation velocity 21. Refraction and wave propagation trajectories 22. Wave reflection, echolocation targets 23. Reverberations 24. Noise in echolocation channels 25. Electric noise in receivers 26. Echo signals, Doppler effect 27. Signal detection and parameter estimation, detection and false alarm probabilities 28. Reception of a known signal with Gaussian noise background, matched receiver 29. Detection threshold, receiver operation characteristics 30. Range equation 31. Range equation parameters 32. Determination of system technical parameters from the range equation 33. Techniques of echo signal imaging 34. Methods of moving objects tracking 35. Review of technical solutions of microwave echolocation systems in automatics and robotics 36. Review of technical solutions of acoustic echolocation systems in automatics and robotics 37. Review of technical solutions of optical echolocation systems in automatics and robotics 38. Development trends in echolocation systems

Prerequisites and co-requisites	

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written exam	60.0%	100.0%

Recommended reading	Basic literature	Salamon R.: Systemy hydrolokacyjne. Wyd. Gdańskiego Towarzystwa Naukowego, Gdańsk, 2006 Skolnik M.L.: Introduction to radar systems. McGraw-Hill, New York, 1980
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	
Work placement	Not applicable