GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Analysis, Recognition and Synthesis of Speech, PG_00064007
Field of study	Electronics and Telecommunications

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	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment

Conducting unit	Department Of Multimedia Systems -> Faculty Of Electronics Telecommunications And Informatics -> Wydziały Politechniki Gdańskiej

Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Józef Kotus
	Teachers	dr hab. inż. Józef Kotus

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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 familiarize students with the basic issues in the field of generating, analalizy and parameterization of the speech signal, The course also presents issues of speech synthesis and speech recognition.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student is able to develop and configure algorithms for voice activity detection. Is able to analyze the temporal and spectral structure of the speech signal. The student is able to carry out the speech synthesis process. The student know the algorithms for changing the duration of the speech signal. The student can configure and run algorithms for automatic speech recognition.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
	[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	The student knows the features of the speech signal, methods of analysis, synthesis, processing and compression of the speech signal, mechanisms for the emission of speech sounds, mechanisms of speech signal perception, methods of parameterization, resynthesis and speech recognition.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
	[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	The student becomes familiar with the operation of IT systems, applications and services used to record, analyze and process speech signals for the purposes of determining the characteristics of the speech signal, enabling speech recognition and used to synthesize the speech signal.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
	[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	The student know with the features of the speech signal and modeling mechanisms of speech sounds production. In addition, he learns the methods of speech signal synthesis, synthesis and processing. He can use the methods of parametrization and resynthesis as well as methods of speech signal compression. He also gets to know issues related to speech processing in real time, in particular for automatic speech recognition. Student understand issues related to speech intelligibility in disturbance conditions. He learns how to improve speech intelligibility under disturbance conditions.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects

Subject contents	
	1. Basic informations on speech signal - applications (communication, medical, control) 2. Structure and activities of vocal tract 3. Structure and model of speech signal 4. Vocal tone 5. Role of vocal tract and nasal tract 6. Formants and antiformants 7. Speech signals spectra 8. Phonetical elements of speech 9. Distinctive features of phonems 10. Microphonems role in speech analysis 11. Acoustic and electric models of vocal tract 12. Features of human hearing and phonetical elements perception 13. Perceptual frequency scales of speech 14. Methods of evaluation of speech transmission quality 15. Time-domain analysis 16. Spectral and predictive analysis 17. Levinson-Durbin algorithm 18. Sonograph analysis 19. Homomorphical processing 20. Spectral smoothing 21. Formant parameters extraction and vocal tone extraction 22. u-law and A-law standards 23. Time-domain parameters and preemphasis application 24. Spectral domain and formant parameters 25. Cepstral and LPC parameters 26. Application of perceptual frequency scales 27. Information redundancy of speech signal 28. Speech resynthesis - spectral-parametric and configuration synthesis 29. Channel and formant vocoder 30. Homomorphic vocoder 31. LPC vocoder 32. Speech compression - examples of coding standards 33. Energy and time normalization of speech signal 34. Phonems and lexical elements segmentation - speech phonetical function 35. Parameterisation methods of speech signal and separating of parameters 36. Isolated words recognition and continuous speech recognition 37. Reference dictionaries creating 38. Parametrical spaces and metrics 39. Speech recognition systems classification

Prerequisites and co-requisites	
	No requirements

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercise	50.0%	40.0%
	Midterm colloquium	50.0%	60.0%

Recommended reading	Basic literature	A. V. Oppenheim: Sygnały cyfrowe. Przetwarzanie i zastosowania. WNT, Warszawa, 1982.
		J. Benesty, M. Mohan Sondhi, Yiteng Huang: Springer Handbook of Speech Processing. Springer-Verlag Berlin Heidelberg, 2008.
		R. Tadeusiewicz: Akustyka mowy. W, Warszawa, 1988.
		Dan Jurafsky and James H. Martin, Speech and Language Processing (3rd ed. draft), August 20, 2024
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		1. Draw and describe a substitute diagram for the production of speech sounds. 2. Methods of voice activity detection in the speech signal 3. Speech intelligibility test in disturbance conditions
Work placement	Not applicable	

Document generated electronically. Does not require a seal or signature.