GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Sound and Image Processing, PG_00048118		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
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	prof. dr hab. inż. Andrzej Czyżewski	
	Teachers	prof. dr hab. inż. Andrzej Czyżewski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

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	45	3.0	27.0	75

Subject objectives

Familiarize student with the issues of processing sound and images.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student understands the limitations resulting from the available processing speed and memory resources in the devices used for the processing of audio and video signals. He understands the issue of hardware acceleration. He knows the rules for the division of computational tasks between cores in multiprocessor architectures.	[SW1] Assessment of factual knowledge
[K6_U07] can apply methods of process and function support, specific to the field of study	The student is able to propose a concept and functional scheme of the audio and video path, in which the sound and image processing processes take place. The student is aware of the possibilities of using simulation environments to verify various concepts and algorithms.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents	**Lecture** 1. Introduction 2. Electroacoustic and image transducers 3. Digital audio track structure, operation, parameters 4. Audio and video distortions 5. Dynamic compansion 6. Sound compression types (lossy and lossless) 7. Temporal and simultaneous masking of sound 8. Perceptual coding of audio - algorithms 9. Fundamentals and standards of multichannel audio 10. Advanced filtration of sound: Adaptive filtration. Noise reduction. Dereverberation. Beamforming. Artificial reverberation. 11. Digital filtration and methods of filter designing. Digital filters classification. Stability. Requirements. FIR filters designing methods: the window metod, sampling in the frequency domain method, method of mean-square-average optimising, Czebychevs approximation method (Remez algorithm). IIR filter designing methods:invariable impulse response method, bi-linear transform method; matched Z-transform method, Yule-Walker method. Effects of limited registry length - quantising. Designing filters in the MATLAB environment. Examples. part I 12. Digital filtration and methods of filter designing. Digital filters classification. Stability. Requirements. FIR filters designing methods: the window metod, sampling in the frequency domain method, method of mean-square-average optimising, Czebychevs approximation method (Remez algorithm). IIR filter designing methods:invariable impulse response method, bi-linear transform method; matched Z-transform method, Yule-Walker method. Effects of limited registry length - quantising. Designing filters in the MATLAB environment. Examples. part II Reduction of noise and distortions in audio and video signals. Digital archiving and restoration of audio. Image restoration. Mediane filtering. Edging. Sharpening. 13. Fundamentals od speech processing, compression and synthesis. Speech production. Vocal tone. Vocal track. Modelling of articu-lation processes. Speech synthesis. Predictive analysis. Speech compression – selected coding standards. Vocoder technology. 14. Speech recognition fundamentals. Normalising energy and time-scale. Phonetic and lexical segmentation. Speech feature extrac-tion methods. HMM. Building reference vocabularies. Speech recognition systems classification, structures and applications. 15. Sound synthesis. Basic methods of digital sound synthesis - sampling, additive synthesis, subtractive synthesis, waveguide synthesis. 16. Elements of computer graphics. Raster and vector graphics. 17. Raytracing, energetic rendering. Texture and scene lighting. Syn-thesis nad advanced image filtration. Keying. Blue box. Morph-ing. Synthetic interactive image. Stereopsis. 18. Video image transformations (2D FFT, cosine transform) 19. Basic techniques of video image processing. Video components. Motion estimation. Redundancy and irrelevancy of images. Im-age coding and compression standards – video codecs, MJPEG, MPEG1/2, MPEG4. Fractal compression. 20. Lecture recapitulation. Multidisciplinary applications of audio and video processing to telecommunications, broadcasting, audi-ology, phoniatry and biomedicine. **Laboratory** 1. Examination of sampling and quantisation influence on sound quality 2. Verification of background modelling algorithms on surveillance cameras images 3. Assessment of object detection and tracking accuracy based on surveillance cameras images 4. Testing of image quality enhancement methods based on superresolution techniques 5. Sound sources localization accuracy testing based on acoustical vector sensor 6. Examination of compression and expansion of sound signal dynamics
Prerequisites and co-requisites	No requirements
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
	51.0%	50.0%
	51.0%	50.0%

Recommended reading		
	Basic literature	Andrzej Czyżewski: Dźwięk cyfrowy. Wybrane zagadnienia teoretyczne, technologia, zastosowania., Exit, 2001, ISBN: 978-83-87674-08-3, Kategorie: Informatyka, Multimedia, Dźwięk cyfrowy, 552 strony, format B5; Alicja Wieczorkowska: Multimedia. Podstawy teoretyczne i zastosowania praktyczne., PJWSTK, 2008, ISBN: 978-83-89244-67-3, Kategorie: Informatyka, Multimedia, 336 stron; Anna Korzyńska, Małgorzata Przytulska: Przetwarzanie obrazów. Ćwiczenia., PJWSTK, 2006, ISBN: 978-83-89244-37-6, Kategorie: Informatyka, Multimedia, Zawiera CD, 110 stron
	Supplementary literature	materiały i artykuły w zbiorach bibliotecznych KSMM
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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