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DEPARTMENT OF OPTOELECTRONICS AT THE SILESIAN UNIVERSITY OF TECHNOLOGY – HISTORY AND TODAY

Abstract. This below study was created on the occasion of the 50th anniversary of the Department of Optoelectronics within the structures of the Silesian University of Technology. The study concerns both the history of the Department of Optoelectronics as well as its research, education and activities related to the organization of scientific conferences.

Keywords: promotion of the Department of Optoelectronics, applied physics, photonics, optoelectronics, acoustics, acoustoelectronics, acoustic emission. cuments.

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APPLICATION OF OPTICAL SENSOR FOR MEASUREMENTS OF LIGHTNING STRIKE CURRENTS

Summary. The paper presents the results of research and analysis of a prototype of a fiber optic current sensor with external conversion, developed at the Department of Optoelectronics at the Silesian University of Technology. It is planned to use this sensor to measure lightning currents. The voltage tests confirmed the good insulation properties of the tested sensor prototype. Good metrological properties of the studied prototype were also confirmed. The paper presents the concept of the lightning strike current measurement system and preliminary measurements on our test stand with a high voltage surge pulse generator.

Keywords: optical fiber current sensor, high voltage engineering, lightning protection system, lightning strike current

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CALCULATION OF SOUND ABSORPTION OF HELMHOLTZ RESONATORS BY NUMERICAL METHODS

Summary. The method of calculation of sound absorption properties of Helmholtz absorbers using finite elements method is presented. The sound absorption coefficient is determined on the base of acoustic pressure and velocity distribution in the neck of a resonator. Thus the acoustic impedance of the top plate of a resonator and sound absorption can be calculated. The proposed method is validated for classical circular hole shaped and slotted systems. A good agreement between analytical methods and the proposed approach is achieved. It was shown that the radiation impedance of the perforated plate, resonator's neck, has a significant effect on its sound absorption. Moreover, for so-called distributed systems (with many holes/slits) the mutual radiation impedance also could influence the absorption properties of the resonator. It is also possible to take into account losses in the resonator in the form of acoustic fabrics or absorbing fibrous materials in a wide configuration of their placement. The effect of the geometry of the chamber and above all the shape of the resonator's neck on sound absorption can be also analyzed.

Keywords: sound absorption, Helmholtz resonator, Finite Elements Method and Boundary Elements Method in acoustics.

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TEST MATERIAL USED TO ASSESS SPEECH QUALITY IN POLAND

Abstract. This paper presents the results of statistical investigations of test lists used in subjective and objective measurements of speech quality (speech intelligibility, the listener's assessment, PESQ, and POLQA). The phonetic and structural statistics of the logatom and sentence lists used for the subjective measure of speech quality and intelligibility performed in the Department of Acoustics, Multimedia and Signal Processing Wrocław University of Science and Technology were researched.

Keywords: Speech quality, speech intelligibility, nonsense words list, logatom list, sentence list

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APPLICATION OF ACOUSTIC METHOD FOR DETERMINATION OF THERMODYNAMIC PROPERTIES OF LIQUIDS

Abstract. The use of acoustic methods to study of the thermodynamic properties of liquids is described. Theoretical background as well as the results of our investigations for various class of liquids under different temperature and pressure conditions are discussed.

Keywords: speed of sound, acoustic method, thermodynamics.

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VOICED FRAME DETECTION IN AUTOMATIC SPEECH RECOGNITION

Summary: In the classic approach to ASR systems, pitch frequency estimation with the use of correlation algorithms consists of calculating autocorrelation functions for all frames, which entails high computational complexity. It is worth ameliorating this process by applying correlation algorithms only to preselected voiced frames. In the proposed approach, a decision about frame voicing is based on determining normalized energy in a speech signal frame, based on signal envelope for four frequency bands. The classification was conducted with the use of a deep neural network MLP.

Keywords: speech signal, automatic speech recognition, quasi-quadrature filter bank, envelope.

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RETROSPECTIVE OUTLINE OF THE ELECTROACOUSTIC SYSTEM IN THE NATIONAL MUSEUM “PANORAMA RACŁAWICKA” IN WROCLAW (1985 – 2020)

Summary: This paper presents a designed and produced electroacoustic system assisting the tour of exhibition intended for a great number of visitors. The microprocessor (and later computer) operated electroacoustic system fulfils two functions: transfers the commentary to exhibition and controls the visitors' traffic. A sound amplification system, which makes it possible to relay at the same time first six, later sixteen language versions of the explanatory commentary to different groups of listeners through loudspeakers and earphones, is presented. Fundamental elements of technological designs applied in the electroacoustic system which was modified during 35 years of operation are also discussed.

Keywords: electroacoustic system, transfer commentary, exhibition.

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INFLUENCE OF THE ARCHITECTURAL FINISH OF ROOMS ON THE SPEECH INTELLIGIBILITY OF VERBAL MESSAGES BROADCASTED BY THE VOICE ALARM SYSTEM

Summary. The paper presents research on the influence of room acoustics on the STIPA speech intelligibility index of verbal messages emitted by the voice alarm system. Using the EASE Aura software, computer modelling was performed for 240 situations and the influence of the selection of the acoustic absorption coefficient α of individual planes on the value of reverberation time and STIPA was checked. Based on the analysis of the obtained results, conclusions were presented on the effectiveness of adaptation of individual planes in the context of improving speech intelligibility of the emitted messages.

Keywords: room acoustics, speech intelligibility, verbal communication, voice alarm system.

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LOUD MUSIC LISTENING VS. THE PERCEPTION OF CHANGES IN PARAMETERS OF MUSICAL SIGNALS

Summary. The paper presents results of research on an influence of auditory fatigue on some aspects of listening condition measured for various groups of listeners. Four experiments have been carried out. The aim of the first one was to find the influence of kind of profession on their hearing loss. The second experiment concerned the Temporary Threshold Shift caused by the listening to loud musical signals after several times of sound exposure. The main interest of the third experiment was the detection ability of changes in spectrum of musical samples obtained after several times of listening to the loud music.

Keywords: hearing threshold, listening fatigue, musical signals.

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THE USE OF THERMOGRAPHY TO IMPROVE THE SAFETY OF ELECTRICAL DEVICES IN THE POWER INDUSTRY

Summary. The paper presents the current scope of application of new techniques and devices based on the analysis of the infrared signal, used to improve the safety of electrical devices in the power industry. Thermography and thermal imaging cameras are used for scientific purposes and in practice. New techniques improve the safety of electrical devices in the power industry, because they make it possible to detect faulty operation of devices, detect emissions of harmful or hazardous substances (including gases).

Keywords: thermography, electric power, safety, gas detection

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BASIC AND ADVANCED ANALYSIS OF ACOUSTIC EMISSION SIGNALS TO DISTINGUISH SIGNALS FROM DIFFERENT SOURCES GENERATING ACOUSTIC SIGNALS IN POWER OIL TRANSFORMERS

Summary. In this paper, the results of analysis of acoustic emission signals recorded in the tested transformers are presented. The analysis included time, frequency, and time-frequency analyses, calculation of amplitude distributions of the signals and defined AE descriptors, determination of the descriptor map on the side walls of the transformers, and a detailed analysis of the selected parts of the signals. Based on the analysis, the AE signals from the following sources were distinguished: noise of the measuring path, partial discharges, phenomena occurring during the magnetization of ferromagnetic materials, and disturbing signals.

Keywords: acoustic emission, power oil transformers, analysis of signals.

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ANALYSIS OF THE POSSIBILITY OF USING CODED PULSES IN ULTRASOUND TOMOGRAPHY

Summary: The paper studied the possibility of improving the detection of lesions in breast tissue using ultrasound tomography employing the signal-to-noise ratio (S/N) increase for transmission and reflection signals by coding sent pulses and matched filtering received signals. Selected signal coding methods were implemented in the model of ultrasound tomography made by DRAMIŃSKI S.A. company and tests were performed on testing objects, agar gel phantoms, and breast phantoms. As a result of pulse coding, a significant increase in the S/N ratio and shortening of the pulse rise time were obtained.

Keywords: coded pulses, matched filtering, ultrasound tomography.

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CORRECTION OF ERRORS OCCURRING DURING THE DETECTION OF PULSE ARRIVAL TIME IN ULTRASOUND TOMOGRAPHY

Summary. Ultrasound tomograph is a new device that can be used to diagnose breast cancer. The ultrasonic pulse generated by the transmitting transducer passes through the breast tissue and reaches the receiving transducers. The determined times of wave propagation between the transducers of the head have errors that cause degradation of the reconstructed images. The paper presents an algorithm for handling the calculated data that allows for the elimination of errors and improves the quality of the obtained sound speed distribution images in the breast tissue.

Keywords: pulse arrival time, sinogram, ultrasound tomography

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ABSORBING PROPERTIES OF NOISE BARRIERS MEASURED BY DIFFERENT METHODS

Summary. The paper reviews the measurement methods for determining the sound absorption of materials and the results obtained using these methods are compared. The reasons of differences between the results of absorbing properties of noise barriers made based on laboratory tests and the in-situ method were discussed. A measurement setup for in-situ testing of noise barriers and a setup for testing in an impedance tube are presented. The results of sound absorption measurement of the tested metal noise barrier, made by the in-situ method and in the impedance tube, in comparison with the results of laboratory tests are presented.

Keywords: sound absorption coefficient, sound reflection index, noise barrier.

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SOUND EXPOSURE LEVELS RECORDED BY CHOPIN AIRPORT MONITORS OVER A PERIOD OF SIX YEARS

Summary. The analysis of data from six noise monitors of Warsaw Chopin Airport from the years 2014 - 2019 is presented. Levels of mean sound exposure for a single event were subjected to analysis. The analysis was carried out to analyze the sound exposure levels for all events during the year, as well as divided by type of air operation and time of day. Changes in sound exposure level do not exceed ± 1 dB over 5 years. The exception was a monitor on the track with little traffic and high community pressure to reduce noise, where the level decreased by 5 dB. The mean drop in the sound exposure level with distance for all operations and years is 2.1 dB/km, but the drop is greater for approaches than for departures. The decrease with distance for approaches did not change in the years 2014 - 2019, while the decrease with distance for departures increased in this period from 1.7 dB/km to 2.3 dB/km.

Keywords: aircraft noise, Warsaw Chopin Airport, A-weighted sound exposure level, noise monitoring system, long-term noise data.

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ON THE USE OF MICROWAVE SIGNALS AND ACOUSTIC EFFECTS FOR MISSILE DETECTION

Summary. The attacks with various types of missiles are a very serious threat to important objects. The paper describes the results of works on the ability of using a microwave detection head to detect missiles. The detection head emits a microwave signal that reflects off objects that appear in its vicinity. The detection head can also be sensitive to acoustic waves. By analyzing the signal from the output of the microwave detection head, it is possible to determine the speed of the attacking missile and, what is very important, the distance from which it was fired. The theory and the results of experiments were presented.

Keywords: microwave signals, missiles detection, radar, acoustic waves, continuous wave, Doppler frequency, microwave-acoustic microphone.

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EFFECT OF DELIBERATE AND NON-DELIBERATE NATURAL VOICE DISGUISE ON SPEAKER RECOGNITION PERFORMANCE

Summary. The problem of voice disguise is usually analysed in the context of forensic or security systems. Automatic speaker recognition systems or forensic experts can be misled by intentional and unintentional as well as natural and technical methods of voice disguise. The research presented in this paper concerns methods of natural voice disguise. The phenomenon of voice disguise was described, an attempt was made to present the systematics and division of voice disguise methods. The acoustic data used in the research was described. The results of the influence of the speaker's emotional state (six basic emotions) and selected deliberate methods (phonation, phonemic, prosodic and deformation) on EER values were presented.

Keywords: speaker recognition, voice disguise.

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APPLICATION OF SELECTED ACOUSTIC EMISSION DESCRIPTORS TO IDENTIFY PARTIAL DISCHARGE

Summary. The paper presents the results of partial discharges (PD) tests in systems with a modeled source, carried out using the calibrated acoustic emission (AE) method. On the basis of the calculated characteristics, a qualitative analysis of selected recorded signals was carried out, as well as a quantitative analysis of selected signal parameters in the time domain and proprietary descriptors calculated in the domain of the discrimination threshold. The obtained results indicate that it is possible to distinguish noise signals from PD signals through ADC and ADP descriptors. The description of signals with the descriptors showed additional possibilities of confirming the presence of PD sources in the examined object.

Keywords: acoustic emission; partial discharge; multichannel system; power oil transformers.

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RECONSTRUCTION OF THE IMAGE OF STRUCTURE WELL REFLECTING THE ULTRASOUND WAVE BY USING DOPPLER TOMOGRAPHY METHOD

Summary. Doppler Tomography is a method that allows to reconstruct cross-sectional images of the examined objects using a two-transducer ultrasonic probe. To obtain an image it is necessary for the probe to move around or along the object to be examined. This is a relatively unknown way of reconstructing images of the interior of objects. In this article, I will present and explain what Doppler Tomography imaging is about. Additionally, I will present the results of simulating images of objects and present the result of the imaging of real elements in the laboratory conditions.

Keywords: Doppler Tomography, image reconstruction, Doppler signal, ultrasound probe.

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MECHANICAL GUITAR PLAYER, A ROBOT FOR AUTOMATIC TESTING OF STRING INSTRUMENTS PARAMETERS

Summary. The article describes the subject of robots playing musical instruments and their use in scientific research. The paper summarizes the prototype phase of a mechanical guitarist used in research on vibrational systems in stringed instruments, such as the guitar. The variants and modules of the right and left hand simulation robot presented in the paper are applicable for various guitars, both acoustic and electric.

Keywords: robot, guitar, musical instruments, robotic musical engineering, robotic musical instrument, music, 3d printing.

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THE IDENTIFICATION OF SIGNALS AND LOCATION OF SOURCES OF PARTIAL DISCHARGES AND MAGNETIZATION PROCESSES IN OIL POWER TRANSFORMERS BY MEANS OF ACOUSTIC EMISSION METHOD

Summary. The paper presents the methodology of oil power transformer testing, including the identification of signals from partial discharges and signals from the magnetization processes taking place in the magnetic circuit of the transformer and the location of their sources. The paper presents an analysis of the results of tests carried out on a selected transformer, in which partial discharges and magnetoacoustic emission were found. The results of localization of sources of partial discharges and magnetoacoustic emission with high activity are also shown.

Keywords: oil power transformers, acoustic emission, magnetoacoustic emission, partial discharge, the magnetization processes, location of sources.

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LOCATION OF LEAKAGE IN METAL PIPELINES BY THE ACOUSTIC EMISSION METHOD USING MODELED AND NATURAL SOURCES

Summary. The paper presents the application of the acoustic emission method for locating leaks in metal pipelines. Verification of the method was carried out in laboratory tests and on a real in-situ object using modeled sources. For laboratory tests, a source was designed and manufactured; the essence of this source is to supply compressed air to a regulated valve and to regulate the stream flowing out of the valve and hitting the pipeline. The source of leakage on the real object was the regulated valve being a part of the pipeline. The conducted tests showed satisfactory accuracy of the location.

Keywords: acoustic emission, gas pipelines, leak detection, leak location.