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Chronicle

67th Open Seminar on Acoustics September 14 – 17, 2021

The Open Seminar on Acoustics is an annual conference, the largest acoustics conference in Poland. It has been bringing all Polish acousticians together for over sixty years. It is organized in turns by different divisions of Polish Acoustical Society – in 2021 by the Krakow Division with the Department of Mechanics and Vibroacoustics, AGH – University of Science and Technology in Krakow and The Committee on Acoustics of Polish Academy of Science. The conference was supported by The International Commission for Acoustics and The Acoustical Society of America, and also by the City of Krakow. The conference presents all sections of acoustics, such as: physical acoustics, environmental, speech, hearing, musical, architectural acoustics, vibroacoustics etc. The Open Seminar on Acoustics was joined with the XXIV Conference of Acoustical and Biomedical Engineering and the 36 Symposium on Hydroacoustics. The conferences were online and were organized as part of the International Year of Sound 2020–2021. The seminar was joined with special session "In Memoriam Professor Zbigniew Engel" and the Workshop "Common noise assessment methods in Europe (CNOSSOS-EU)".

Abstracts

4th order ambisonic microphone in acoustic field analysis

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Ambisonics is a spatial sound technique that allows for localising sound sources in three – dimensional space. An analysis of the recordings made using an ambisonic microphone provides information on the direction of arrival (DOA) of the sound; the accuracy of such analysis depends on the number of microphone capsules forming the microphone array. This paper presents the identification of DOA using a 4th order spherical microphone array as well as an attempt to localise sound reflections based on the analysis of spatial impulse responses.

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A method of precise pulse onset determination using the Akaike Information Criterion for ultrasound transmission tomography

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Information criteria used in statistics for model selection can be used to accurately determine pulse transition times in transmission methods. The most popular information criteria are the Akaike Information Criterion (AIC) and the Bayesian Schwartz Criterion (BIC). These criteria are considered the most reliable tests of model type and structure and are computationally simple. Furthermore, they are applied directly to the dataset for estimation and do not require a dataset for verification. In this paper, an algorithm developed according to the AIC criterion is used to determine the transition time from transmission tomography measurements acquired with a multi-element ultrasonic ring array, which is the scanning element of a novel prototype of ultrasound tomography device for detecting and estimating the malignancy of female breast cancer in vivo. As a result of the conducted research, a special algorithm for precise search of the onset of the recorded receiving pulse was developed. The algorithm was tested in an aqueous environment using elementary pairs of transmitting and receiving ultrasonic transducers of a tomographic ring array.

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A new direct-sequence spread spectrum signal detection method for underwater acoustic communications in shallow-water channel

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Direct-Sequence Spread Spectrum (DSSS) is one of the modulation and coding techniques used in Underwater Acoustic Communication (UAC) systems for reliable data transmission even at low signal levels. However, in a shallow water channel, there is a strong multipath propagation which causes a phase fluctuation of the received signal, affecting the performance of the spread-spectrum system. The article presents a new method of DSSS signal reception. The classical DSSS reception method is that

the detection of information is performed based on the signal at the output of the filter matched to the spreading sequence used in the transmitter of a UAC system. The method presented in this paper relies on differential information detection based on the value of the correlation coefficient between adjacent modulation symbols without applying matched filtering. A positive value of the correlation coefficient means that the given modulation symbol carries the same information bit as the previous one; a negative value means that the opposite bit has been transmitted. Simulation and measurement tests of underwater acoustic communication in strong multipath propagation conditions have shown that the proposed method allows obtaining lower values of the DSSS transmission Bit Error Rate (BER) than the reception method based on matched filtering while maintaining the same data transmission rate.

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Air-coupled ultrasound for nondestructive testing of materials

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The presentation discusses the use of air-coupled ultrasound (ACU) for nondestructive testing of engineering materials. Theoretical background, as well as practical examples of automated inspection of engineering materials, will be discussed.

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Analysis of factors influencing the measurement result of the reverberant sound absorption coefficient in laboratory conditions

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There are still discrepancies in the measurement results in spite of the standardized methods of measuring the sound absorption coefficient in the reverberation room. They appear especially in interlaboratory tests. The research used the method included in the EN-ISO 354: 2003 standard to determine the sound absorption coefficient. Subject of the scientific research was to investigate the impact of measurement techniques (Maximum Length Sequence method and interrupted noise method for both T20 and T30 evaluation ranges), humidity in the test room, sample seasoning and sample fitting and finally the influence of room variability on the measurement results. Tests were performed in two reverberation chambers. The study included two types of materials. Samples (1) made of identical pieces of mineral wool (ISOVER glass wool and ROCKWOOL rock wool) and (2) of fibreboard. Mineral wool was of different thicknesses. Among the measurement techniques, the smallest dispersion of the results of the reverberation time was obtained with the MLS-T30 method, and the highest differences in the results were caused by executing the test in another room (reverberation chamber). There was no significant influence either with the increase of humidity or the careful arrangement of the test sample from the components on the final result of the measurement.

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Application of diversity combining with RLS adaptive filtering in data transmission in a hydroacoustic channel

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When transmitting data in a hydroacoustic channel under difficult propagation conditions, one of the problems is intersymbol interference (ISI) caused mainly by the effect of multipath propagation. This phenomenon leads to a decrease in transmission parameters, and sometimes completely prevents it. Therefore, we have made an attempt to use diversity combining with Recursive Least Squares (RLS) adaptive filtering to improve the quality of data transmission in a hydroacoustic channel with strong reflections. The method was tested in simulation and during measurements in the real environment. The influence of the method on data transmission in the hydroacoustic channel was examined in details. The obtained results allows us to draw conclusions regarding the purposefulness and use of diversity combining and RLS adaptive filtering in order to improve the quality of data transmission by reducing the effect of ISI.

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Application of high-density sound absorbing materials for improving low-frequency spectral flatness in room response

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A room impulse response obtained for complex-valued boundary conditions on wall surfaces was used to determine the frequency response of arbitrary shaped room. Based on theoretical findings, a numerical procedure was developed to test the effectiveness of a high-density sound absorbing material for improving low-frequency spectral flatness. The impedance of absorbing material was determined using the two-parameter Komatsu model. The simulation results have shown that the smoothing effect of the frequency response becomes apparent when the thickness of absorbing material is large enough. This is because as the material thickness increases, the sound absorption tends to increase at lower frequencies.

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Application of the scattering matrix formalism to the analysis of reflective acoustic muffler attenuation for single-mode excitation

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The aim of this paper is to apply the scattering matrix formalism to determine the acoustic attenuation of

an simple reflective muffler for single-mode excitation. The analysis was performed for two independent sound fields in the form of single axisymmetric modes (0.0) and (0.1) generated using the mode generator. The scattering matrix formalism is the most general and can be applied to single-port (or N-port) acoustic systems as opposed to the transfer matrix formalism which requires two-port acoustic systems. Applying the scattering matrix formalism to the analysis of acoustic mufflers provides all the necessary information on how a given element modifies the acoustic field. A measurement set up, results and analysis are presented.

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Auditory perception of spatial resolution spherical ambisonic playback system validated by minimum audible angle parameter

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In this study we present the results of the psychoacoustic tests performed on the horizontal plane of spherical ambisonic playback systems. The aim was to evaluate the accuracy of human perception of localisation and movement of sound sources by determining the minimum audible angle parameter. We based our research on existing paper published by Mills, where physical sound sources were used. The experiment incorporated 2 different listening tests, where MAA was determined using two types of signal samples: tones and Gaussian noise. The panel of subjects consisted of experienced listeners. Achieved outcomes are coherent with the psychometric functions determined using a physical sound source. Analysis of the results is a foundation for further research focused on perception of the phantom sources produced in ambisonics.

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Between (pseudo)silence and noise – the ontological status of music in the lo-fi environment. The case of contemporary shopping malls

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Silence and noise are two extreme situations for the auditory system. Both categories escape simple classifications especially in the context of lo-fi acoustic environments. Modern shopping malls are interesting examples of soundscapes in which the recipients experience diverse acoustic phenomena. To what extent the context of lo-fi environment can change the perception of silence and noise? Is programmed music (present in shopping malls) still music or rather noise? These are selected questions that shape the discussion on the ontological status of music in lo-fi environments and its possible diversity at the intra- and interindividual level. The methodology of research was constructed around the soundwalking technique. More than 200 participants homogeneous in terms of age took part in the present research. Their tasks were to take a soundwalk in one of the selected shopping malls in Warsaw. As a result, an extensive set of qualitative and quantitative data was obtained, which was subjected to a multi-stage analysis: thematic (text data), statistical (quantitative data), auditory and spectral (audio ?les). The results show that for the recipients subjected to the strategy of sensory adaptation and even habituation, the ontological status of music is ambiguous. This conclusion provokes further discussion on the long-term consequences of noise pollution and the problem of acoustic design what requires further interdisciplinary research.

This research was supported by Research Grant Sonata 12 (No. 2016/23/D/HS2/01773).

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Bimodal operation's role in detection of the breathing phenomena

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Auscultation, despite being subjective and hardly sharable, still plays an important role in the diagnosis of several respiratory conditions. To make this technique even more useful, knowledge about breathing sounds, their properties, recording and analysis must be constantly increased. The aim of this research was to investigate how the bimodal operation, including sound and vision perception, affects the effectiveness of the breathing phenomena detection for physicians and medical students. Actual pediatric breath sounds recordings were presented in three different conditions – audio only, visual representation only (spectrogram) or both together. F1-score, sensitivity and specificity parameters were calculated compared to the established gold standard (GS) The acoustic recording's visualisation (with no visual training) increases sensitivity of real-life auscultation signal phenomena recognition by 4 p.p. and 2 p.p. (for physicians and students, respectively). For the majority of the recipients, the most important information during auscultation recordings analysis remains sound. 12% of all participants, although having just limited experience with the spectrogram, found the new form of auscultation's results presentation more useful than evaluation of sound only. Providing the auscultation recordings with their visualizations may be helpful and beneficial in terms of accurate diagnosis or monitoring, as well as medical education, only if understood properly. In other cases, visual cues may be an additional distractor, disabling focusing on the recordings' content or even becoming a source of misinterpretation.

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Calibration of hydrophones at low frequencies using the vibrating water column method

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This article describes the preliminary results of testing a low-frequency hydrophone calibration system using

acoustic coupler and the vibrating water column method (based on IEC 60565-2). The calibrated hydrophone is immersed in the water column in a fixed transducer position, while the pressure field is generated by the vertical oscillating movement of the water column by means of the vibration exciter. The paper presents the justification for the need to develop an acoustic coupler for the calibration of hydrophones at low frequencies, a description of the structure of the acoustic coupler and the preliminary calibration results of selected hydrophones made during the tests of a new acoustic coupler station at the Acoustics, Ultrasound and Vibration Laboratory of the Central Office of Measures.

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Classification of flooded areas in a natural wetland during early spring season using various polarimetric SAR methods

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One of the major limitations of flood detection by remote sensing is the presence of vegetation. This study focuses on a flood classification using Radarsat-2 Quad-Pol data in a natural floodplain during leafless, dry vegetation state. A supervised classification of a data set composed of nine polarimetric decompositions and Shannon entropy was conducted, and followed by the predictors' importance estimation to reveal which decomposed component had the strongest effect on classification models. Four variants of polarimetric speckle filtering were tested to see if this step influences the results. Also, the impact of window size of polarimetric decomposition and speckle filtering on classification results was investigated. The highest classification accuracy was 0.84 for the IDAN filter with decomposition window size 9 and speckle filter size 11. The lowest classification accuracy (0.69) was obtained for the box car filter with decomposition and speckle filter window size 9 and 5, respectively. The volume component of Pauli decomposition was the most important for model that produced the best classification results.

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Comparison of homogeneous and 2-part piezo actuators – numerical and experimental results

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This work presents numerical and experimental results of comparison of homogeneous and 2 part piezo actuators in active vibration reduction of plates. The first numerical model consists of a steel plate clamped on all sides with 2 piezoelectric actuators attached. One of these actuators is used to excite the plates' vibrations and the other is used for vibration reduction. Modal analysis were performed to find first 5 modes of the plate, than harmonic analyses for each chosen mode for vibration reduction. The goal function for the first mode was minimum of sum of displacement vector sums of all the nodes making one surface of the plate. The second numerical consists of a steel plate clamped on all sides with piezo elements attached. For this model the number and placement of piezo elements as well as dimensions are the same as for the physical experiment. Similarly like for the first model first modal analyses were performed to find plates modes and then harmonic analyses for vibration reduction for chosen modes. Vibration reduction analyses were performed using 2 goal functions: first, the same goal function that was used for the first model, than analyses were repeated for a second goal function – minimum voltage on a piezoelectric sensor – which was used in physical experiment. All numerical analyses were made using ANSYS software. The final results presented in this work are the results for vibration reduction obtained during physical experiment using prototype piezo actuators with a homogenous and 2-part build.

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Curve squeal – how is it influenced by different conditions? Statistical analysis of the noise generated at curves on the Stockholm metro

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The paper deals with one of the most annoying noise generated by the railway traffic, that occurs while a rail vehicle negotiates a curve. Understanding of curve squeal phenomenon and knowledge about factors promoting its generation may be essential while developing effective measures against this noise. The current investigation was based on the noise data recorded during a period of one year by an onboard monitoring system that is used in Stockholm metro. Results of a statistical analysis show how the occurrence of curve squeal is influenced by selected parameters considering: track alignment (e.g. curve radius, curve location outside/inside of tunnels) environmental and operational conditions (precipitation, air temperature, air humidity and vehicle speed). A closer look into characteristics of squeal noise is also included.

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Determining of the sound power of the fan in *in situ* conditions using the virtual reference source method

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Acoustic power is one of the basic parameters characterizing the sound source and has a direct impact on the acoustic climate in its surroundings. Therefore, the determination of the acoustic power of machines is a practical problem. While there are many methods of determining the acoustic power, each of them has its own limitations. The authors presented the implementation of a comparative method of determining the acoustic power with the use of a virtual reference source. The method was used to test a high-efficiency flue gas exhaust fan installed on a laboratory stand. The sound source was placed in the geometric centre of the fan and the acoustic field distribution

in the room was determined using the geometrical methods. After determining the influence factors, the value of the source power was determined by means of the Moore-Penrose pseudo-inverse. Since the problem under study belongs to the inverse problems, the Tikhonov regularization was used, where the value of the parameter α was determined by the L-curve method.

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Dimensional analysis of simple acoustic metamaterials

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Acoustic structures based on metamaterials are gaining more and more popularity. Because of their properties, in particular configurations they can be used as sound diffusers, sound absorbers, or for limiting the sound transmission (acoustic screens and partitions). Due to the thermoviscous losses and sound dispersion that occur in such structures, the depth of acoustic panels based on metamaterials can be significantly reduced in comparison with regular sound diffusers and absorbers for the same frequency ranges. Because of their increasing popularity, it is necessary to find a way for scaling acoustic metastructures to be able to use them in scale models of the designed rooms in which they are to be used. The paper describes a dimensional analysis of simple acoustic metamaterials. It is a starting point for further research on building scaled acoustic panels based on metamaterials and the possibilities of using scale measurements for designing acoustic metamaterials.

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Directivity pattern of Distributed Mode Loudspeakers

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Distributed Mode Loudspeakers are characterized by a much wider angle of radiation than the conventional transducers. They behave as non-coherent sound sources and produce a more dispersed acoustic field. Such a loudspeaker placed in a room presents different properties of the sound field than a pistonic transducer.

The frequency responses obtained from measurements of Distributed Mode Loudspeakers taken in neighbouring points often vary significantly between each other. Furthermore, unlike the pistonic transducers, the Distributed Mode Loudspeakers do not produce the highest sound pressure levels on their axis. The goal of this work was to reveal fine details of the three dimensional radiation pattern of this kind of transducers.

This paper describes directivity characteristics of Distributed Mode Loudspeakers, obtained from measurements of frequency responses on the hemisphere, with angle resolution of 10 degrees. The measurements were taken with a linear sweep sine signal of long duration. Two dimensional plots of sound pressure level (SPL) versus frequency at selected points on the hemisphere and of SPL versus angle at selected planes will be presented, as well as 3D plots of SPL over the entire hemisphere viewed at different angles.

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Educating of architectural students in acoustics as an answer to the reverberant noise standard

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Implementation of the new standard PN-B-02151-4 – Building Acoustics – Protection against Noise in Buildings, Part 4: Requirements for Reverberation Conditions and Indoor Speech Intelligibility and Testing Guidelines imposes on architects an obligation to design interiors in compliance with acoustic requirements. The above regulations give rise to the need to educate future architects so that the standard can be practically employed in their professional career. The aim of the article is to describe a teaching method tailored for students of architectural design compliant with the standard requirements without using specialized software programmes. The paper presents two types of design tasks that form a basis for teaching students within the framework of design practice in building physics – acoustics. The article shows how to teach students to facilitate full acquisition of the rules governing interior design compliant with reverberation parameters suitable for the assumed function, and to enable thorough comprehension of interior design.

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Effect of sleepiness in the voice on speaker recognition performance

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The issue of the influence of speaker state on voice recognition has been analysed mainly in relation to forensics and biometric security systems. Sleepiness in the voice is a rather under-researched problem, and the few works in this area focus almost exclusively on the recognition of sleepiness rather than on its influence on the change of the speaker's voice characteristics. This paper discusses the issue of the influence of the speaker's state on voice recognition, describes the acquisition method of the acoustic database of voice drowsiness recordings used in the tests. It also discusses the subjective sleepiness scales used in the study and presents the results of the influence of sleepiness on the effectiveness of automatic speaker recognition based on a classical system using the MFCC parameterisation and the GMM classification.

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Estimation of sound power level of machine by inverse method

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The paper presents the inversion method as a method of estimation the sound power level of machines operated in

industrial environments. Values of the partial sound power sources of machine components could be predicted based on the distribution of sound field parameters around the machine. Assigning partial sound power levels of machine components allows to effective selection of efficient noise protection solutions for this machine. Measurements were carried out in a real mechanical workshop. The multi-channel measurement system for simultaneous recording of sound pressure levels and the angle of phase angle shift were used in measurements.

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Experimental tests of the acoustic properties of sound-absorbing linings and cores of layered baffles

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The article presents the results of research on the acoustic properties of materials used as sound-absorbing linings and cores in baffles of anti-noise protection. Using an impedance tube the spectral characteristics of the normal incidence sound absorption and sound transmission loss indices of 12 specimens of mineral wool with different density and thickness were determined. From these characteristics, the single-number weighted sound absorption coefficient aw and the sound reduction index R_w were calculated. To calculate the value of the R_w index on the basis of surface mass of the mineral wool specimen, a new formula was proposed. The insertion loss of an acoustic enclosure with one, two and three-layer walls with dimensions of 0.7×0.7 m, containing mineral wool, was determined. The best efficiency was achieved for the enclosure made of walls of layers: mineral wool, placed on the sound source side, steel plate and aluminium plate.

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Hydroacoustics Laboratory at Gdynia Maritime University

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The article presents the most important conditions and limitations affecting data transmission in shallow waters. It describes the hydroacoustics laboratory, created at the Gdynia Maritime University as part of the Regional Excellence Initiative program. Its equipment is given and the main tests carried out in laboratory conditions and in the real environment are characterized.

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Impact of the level of noise and reverberation on the reaction time of listeners in the perception of logatoms

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The article presents the results of research regarding the impact of the degree of distortion (reverberation) and noise of the logatom (nonsense word) on the listener's reaction time. The study aimed to determine the maximum reaction time of listeners, which will allow determining the time after which the logatom will be exposed in the speech quality assessment method with an alternative choice. The research was carried out with the participation of a group of ten students. A strong relationship between the results obtained and the concentration of the listeners was found, as well as the effect of fatigue, training, and the gender of the listener. The obtained results indicate that in the method with an alternative choice before the logatom emission should appear 1.1 s initial sequence, which will eliminate the situation when the listeners did not recognize the initial phoneme transmitted from the logatom.

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Impact sound reduction measurement method for lightweight floor screed

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Development and implementation of a new product in the form of a lightweight screed with high impact sound reduction require a lot of measurements of different aggregates of lightweight elements and filling. The manufacturing process influences the final parameters of the solutions as well. This is why a method was developed, that allowed a comparison of many different samples within one measurement session. The measured samples must therefore be small and easy to move. In the paper, various possibilities of impact sound reduction measurements were analysed being different variants of the normative methods and those existing in the literature on the subject. Based on the obtained results, it was shown that for lightweight floor screeds, sound pressure level measurement is more reliable than vibration acceleration measurements. The top vinyl layer used between the tapping machine and the sample did not influence the results significantly and protected the sample from being distorted by the tapping machine hammers.

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Impulse response method using for test of acoustic properties of building materials

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In the structural acoustics and the environmental acoustics an important role plays knowledge of the acoustic characteristics of materials used in construction of wall surfaces. There are many test methods for determining parameters such as the absorption coefficient, the reflection coefficient or sound insulation index designated in the laboratory or in situ condition. The present paper concentrates on absorption coefficient and possibility to measure it in *in situ* condition using the impulse response method. Main aim of presented study was to check if there is possibility to apply impulse method in small reverberant room to determine absorption coefficient of small part of wall construction.

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Influence of cavity edges shape on flow induced noise

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In this paper, impact of the cavity shape on flow-generated noise is analysed. As reference model, the classic rectangular cavity with perpendicular corners was used. The impact of both upstream and downstream edges was analysed. In this paper, authors used hybrid method, where the flow was computed by means of Spalart-Allmaras Detached Eddy Simulations (DES) model, and the acoustic wave propagation was calculated by Curle acoustic analogy.

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Influence of the elastic cavity walls on cavity flow noise

Paweł Łojek, Ireneusz Czajka,
Katarzyna Suder-Dębska, Andrzej M. Gołaś

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In this study, computational fluid dynamics and computational aeroacoustics methods were used to investigate the influence of the elastic cavity walls on the noise generated by the flow over rectangular cavity. Two cases were considered and compared, one with rigid cavity walls, and one with elastic walls. In the latter case, the movement of the walls were solved by finite element modelling and coupled with CFD simulations. The noise generated by the flow over cavity was computed using Ffowcs Williams & Hawkings acoustic analogy. The increase of the sound pressure level for elastic walls case at frequency range of 1 kHz to 10 kHz is observed, compared to the rigid walls case.

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Leaky partial updates in application to structural active noise control

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Structural active noise control (ANC) belongs to the group of most demanding algorithms, when it comes to computational power. One of the ways to lower this demand is to use algorithms with partial update of the coefficient vectors. Such algorithms are well known in signal processing, but their leaky versions were rarely reported. This paper fills this gap by showing how leaky partial updates can be applied to a structural ANC application, with the number of actuators higher than the number of error sensors.

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Masking release – effect of age and hearing impairment

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One of the other parameters which may describe one's ability to perceive speech properlynt is so-called masking release. It may be interpreted as the difference between speech reception threshold (SRT) obtained in stationary and fluctuating noise. Normally hearing (NH) subject or people with minor hearing impairment (HI) can effectively use the part of the useful signal which occurs in the "gap" in the noise (associated with the fluctuation of its envelope), and thus, is presented as if in silence Here, the results of the indepentend experiments were analysed comparing SRT values obtained in the test specific noise and modulated icra5-250. In the first experiment, NH and HI listeners were taken into account, while in the second – HI in aided (own and 'virtual' hearing aids) and unaided condition. As observed, for HI listeners, values of masking release remain smaller than in NH, which suggests that they cannot take advantage of the fluctuation in maskers envelopes. Mean values for are 3.9, −1.4 and −0.2 for mild, moderate and severe HI respectively – over 12 dB worse than young NH. In the case of subjects with small hearing deficits, about 10 dB dynamics of changes in the thresholds of speech intelligibility in stationary noise translates into a dynamics of almost 20 dB in the case of icra5-250 noise. Among the listeners in whom TSN SRTs achieve significant values, the relationship between speech intelligibility in stationary and modulated noise becomes stronger. Obtained results show that the masking release is less efficient in the case of the people with hearing loss. What is worth mention is the fact that for some individuals, speech intelligibility in fluctuating maskers is worse than in stationary noise – apart from the efficacy of cognitive processing and/or temporal and spectral resolution (as clearly seen in normally hearing listeners), also hearing threshold itself plays an important role in speech perception in various masking conditions.

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Masking sound distribution in an office open plan room

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In an open plan office room with a volume of 218 m^3, the uniformity of the masking sound was tested. The tests were performed using the computational method. The masking sound was emitted by omni-directional sound sources emitting pink noise. These sources were placed in a sound-absorbing suspended ceiling. The uniformity of masking sound was determined by the standard deviation of the A-weighted sound pressure level at the workstation. The study considered the impact of the number and deployment of masking sources. It was found that the geometry of the room (room proportions $4.8 \times 1.8 \times 1$), uneven distribution of sound-absorbing materials and acoustic screens, and even (in a square grid) arrangement of masking sources did not result in an acceptable non-uniformity of masking sound at workstations. Greater uniformity of the masking distribution can be achieved by placing the masking sources in one line parallel to the surface of the longer side wall of the room. In order to obtain the standard deviation from the value of the A-weighted sound pressure level at workstations, not greater than 0.8 dB, it is necessary to use the same number of masking sources as the number of columns

of workstations (the columns are workstations placed next to each other perpendicular to the longer side wall of the room).

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Method for the correlation coefficient estimation of the bottom echo signal in the shallow water application using interferometric echo sounder

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The article presents a new method for the assessment of bottom echo correlation coefficient in the presence of multiple echoes. Bottom correlation coefficient is a parameter that characterizes spatial properties of echo signal. Large variability of the bottom shape or properties (for example caused by the presence of bottom objects) and the presence of the acoustic shadow strongly influence the value of the correlation coefficient. There is a problem, however, in the proper determination of correlation coefficient of the bottom echo when more than one echo is present. In the shallow water application, the echoes coming to the hydroacoustic array from various directions influence the measured value of the correlation coefficient. The method proposed by the authors challenges this issue by applying a subarray processing based on the initial depth estimation. The article presents the preliminary research results and describes the limitations of the proposed method.

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Methods for assessing acoustic parameters of the barriers with photovoltaic modules

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Acoustic barriers are constructed from elements with specific sound insulation and specific sound absorption properties. Placing photovoltaic panels on existing acoustic barriers may change their sound absorption and sound insulation. Typical rigid photovoltaic panels generally exhibit poor sound-absorbing properties. When installed on existing absorbent barriers, the sound absorption of the barrier may be significantly reduced.

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MFCC and GFCC-based x-vectors for voice pathologies identification: a comparative study

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Current epidemiological situation caused increased need for telemedicine technologies, including computer aided diagnosing systems and remote diagnosing of infectious diseases, e.g. laryngeal pathologies. Many studies regarding automatic identification of voice pathologies based on speech signal have been published. However, most of them use sustained vowels and only a few incorporate continuous speech. In this study a novel approach to laryngeal diseases identification is presented. Speaker embeddings called x-vectors are extracted from continuous speech signals and used for classification of three diseases: dysphonia, chronic laryngitis and vocal cord paralysis. Two feature sets, namely mel-frequency cepstral coefficients (MFCC) and gammatone frequency cepstral coefficients (GFCC) are used for x-vectors extraction and a comparative analysis of the results yielded by genetic algorithm-based classifiers trained on each of the feature sets is performed. The best classifiers reached the accuracy rate of 81.25%, 87.5%, and 85.03% for dysphonia, laryngitis and vocal cord paralysis respectively.

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Model of the acoustic barrier with the use of layered structures of sonic crystals

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The paper presents the results of the calculation of the insertion loss of the acoustic barrier model with the use of layered structures of sonic crystals and the distribution of acoustic pressure levels around this barrier. The finite element method was used in the calculations. The structure geometry was defined on the basis of real spectra of industrial noise. The developed model includes several sound attenuation mechanisms in order to increase the efficiency and frequency range (resonance in low frequency range, absorption in the medium and high frequency range, and scattering also in the medium and high frequency range), as a result of which it is possible to obtain an insertion loss close to 30 dB in the ranges of occurrence of the dominant components of the industrial noise spectrum. The best results were obtained with the use of multi-layer resonators in combination with the sound-absorbing material on the outer side. In the 800–5000 Hz range, the insertion loss did not fall below 20 dB. The results were compared with other models of acoustic barriers using sonic crystal structures.

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Noise emission from various shape rods at low-moderate Reynolds number

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Aeroacoustics source localization is an important experimental tool and the first step in order to know the mechanism of noise generation. Aeroacoustics sounds are the class of sounds that are generated by the movement of air passed objects or edges. The sounds can also be generated by objects moving through the air. The sound generated by a non-vibrating object in a flow is also known as the aeolian tone. The flow around the various shape of rods is one of the major aeroacoustics noise source mechanism. Such rods

represent simple models for technical applications like part of the landing gear of planes, train pantographs, antennas, vehicles part or bridge. The purpose of this paper is to clarify the influence of the rod shape in the noise generation mechanism in a low-moderate Reynolds number. In general, this noise is produced by a fluctuating force exerted by the rods on the surrounding fluid, leading to a dipole acoustic field. This fluctuating force is associated with the periodic vortex shedding from opposite sides of the cylinder, arranging themselves into a double row called the von Karman street. Due to the practical importance of rods wakes in many engineering problems, much attention has been devoted to manipulating vortex shedding with active and/or passive means. In this work, the situation when various shape rods are in the area of laminar-turbulent flow were analysed. The measurements were carried out for single circular, square, U-shape rods to study the noise effect depended on the Reynolds number.

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Nondestructive testing of materials using guided ultrasonic waves

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Nondestructive testing (NDT) is integral to the maintenance of many modern engineering structures. New structural components, including composites or adhesively joined materials, are prone to complex types of defects, which are usually invisible to the naked eye and can significantly decrease structural integrity. Safety requirements of hi-tech industries, such as aerospace, lead to constant improvement and development of new diagnostic techniques. Among various methods, ultrasonic inspection remains widely used due to its reliability and flexibility. Typical US diagnostic utilizes probes in either through-transmission or pulse-echo configurations, which enable imaging of the internal flaws inside the material. However, the probes need to be positioned over the inspected surface to perform a full scan which is usually time-consuming, especially for large structures. An alternative method of US inspection is possible using so-called guided waves, which are able to propagate over long distances in plate-like structures. The guided waves require only a single point of excitation to probe large areas of the specimen and are very sensitive to various types of damage.

We present a method for NDT testing of engineering plate-like structures using local wavenumber estimation (LWE) of guided waves. The method involves exciting the structure to propagate Lamb waves over an area of inspection. The area is then scanned in numerous measurement points using a laser Doppler vibrometer (LDV). The resulting spatiotemporal dataset is then processed using the LWE algorithm to produce 2D maps, from which the information on local plate thickness or damage can be inferred. The method's effectiveness is demonstrated on various types of structures, including homogenous aluminum and multilayer composite plates.

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Numerical directivity simulations of speaker arrays for omnidirectional sound source quality assessment

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Omnidirectional sound sources are standard devices used in numerous acoustic measurements, such as ISO3382, ISO140, ISO354, or other applications to provide information about sound diffraction around objects. State of the art contains several engineering reports from the omnidirectional source design. We also can meet some commercial applications. However, there is no universal design method for this kind of source, which can answer how the omnidirectional sound source should be designed, which size and number of the transducers are the best, and other general features electroacoustic design. This paper used the Finite Elements Method (FEM) to derive the directivity patterns of different speaker arrays such as spherical speaker arrays and the most popular polyhedrons, where the number of transducers varied from 4 to 36. The influence of transducer size and enclosure size was also preliminarily investigated. With the strict omnidirectional quality measures, we assessed the simulation results and analysed the influence of transducers size and number parameters on final omnidirectional sound source performance.

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Numerical investigation of noise generated by an axial fan installed in a pipeline

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The article presents the results of numerical calculations of noise generated by an axial fan installed in a ventilation duct with a circular cross-section. The research takes into account the installation of the axial fan due to the distance of the rotor from the curvature of the pipeline. The uRANS turbulent flow modeling methods were used in the calculations. The uRANS stands for the Navier-Stokes equation with Reynolds averaging in the version that takes into account the non-stationarity of the flow. The purpose of the work is to determine the sound power in the vicinity of the sound source. The decisive parameters affecting the noise emitted will be the length of the installation in front of and behind the rotor. The propagation of acoustic disturbances in the far field was modelled using the aeroacoustics analogy of Ffowcs-Williams and Hawkings.

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Pilot studies of noise annoyance in relation to time, amplitude, and frequency characteristics of sound

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The aim of the pilot study was to assess the noise annoyance in relation to the time, amplitude and frequency characteristics of the sound in a representative office acoustic environment. The test method used the ALS test from

the Vienna Test System. At the test stand, a set of necessary measuring and diagnostic equipment was completed and 3 virtual office acoustic environments were developed with a constant sound pressure level of 55 dB – environment B (conversations), environment C (office equipment), environment D (all noise sources combined). Environment A was adopted as the reference – a quiet office room without additional noise sources. In order to reproduce the acoustic environments, 14 typical sources of office noises were transferred to a virtual 3D sound environment and converted into binaural sound. Psychoacoustic parameters were also determined for each noise source. During the exposure to each of the aforementioned acoustic environments, the subjects performed the ALS test (work efficiency test), and then assessed the given environment using a questionnaire. The order of presentation of the acoustic environments was based on the Latin square plan to exclude the influence of the test order on the evaluation results. Statistical analysis of the test results showed no statistically significant differences between the mean values for different environments in the ALS test, both in terms of the number of performed calculations and the percentage of errors. The subjective feelings of the respondents were not reflected in the results of psychological tests.

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Possibilities to improve imaging in Doppler tomography using selected algorithms and measurement system components

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The method of Doppler Tomography is a modern method that allows to reconstruct stationary images of the interior of studied objects. Such objects may be elements of the human body. In order to enable correct imaging, it is necessary to introduce necessary modifications to the original method. It is necessary, for example, in order to obtain an appropriate image resolution. For this particular purpose, an algorithm has been used that allows the recording and calculation of Doppler frequencies in real time. This is particularly important because image reconstruction is performed on the basis of changes in these frequencies. An additional element that requires attention is the ultrasound probe used to send and record the signal that is the basis for the image calculation. The probe must meet appropriate criteria. Among others, its directional characteristics must have a specific shape. This issue will be explained and described in detail in a smaller paper. The issue of improving the quality of Doppler Tomography imaging is particularly important because it can be a supporting method for CT, mammography or ultrasonography.

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Pseudorange error estimation in mobile GNSS Android system

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In the past, GNSS (Global Navigation Satellite Systems) were only offered for a narrow group of recipients. Nowadays, thanks to mobile devices, they are available to anyone and everywhere. Personal navigation, searching for POI (Point of Interest), etc., had become a basic essential activity. Thanks to the widespread and availability of smartphones each user can obtain information considering his or her location even in an unknown environment. This paper is focused on a study, considering the pseudorange error estimation in case of Android-powered mobile devices. It describes a measurement campaign, carried out in varying urban environments, including two popular consumer devices from different manufacturers running Android OS. Based on this, respective conclusions and remarks are given.

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Sound diffuser made of acoustic metamaterial: numerical and experimental investigation

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The use of metamaterials in room acoustics is becoming more and more popular. Their advantage is the possibility of adjusting the parameters of the systems in the desired frequency range and the reduction of dimensions compared to the existing solutions. This paper discusses the numerical design and experimental verification of sound diffuser based on the acoustic metamaterials: a slit with added quart-wave length resonator. The transfer matrix method is used to make a numerical model of the metamaterial cell, which was used to build a model of a diffuser composed of $N = 7$ cells. Then, the dimensions of the diffuser were optimized to obtain the sound diffusion in a wide frequency range. The sound dispersion coefficient was also calculated using the FEM method. The numerical results were compared with the measurements and it was shown that it is possible to make a broadband sound diffuser with the use of metamaterials.

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Soundscape assessment in laboratory workspace relative to office space

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This article presents the soundscape assessment results for laboratory space relative to office space. Laboratories are classified as a workspace that requires high concentration during work. Objective measurements revealed that laboratories do not exhibit exceeded permissible sound levels. Nevertheless, workers complain about their unfavourable soundscapes. The reason for this is the noise originating from apparatus and technical procedures. Acoustic pressure level measurements are not sufficient to assess acoustic comfort in a workspace. The subjective assessment of a soundscape is of equal importance to objec-

tive acoustic measurements. It makes it possible to identify and eliminate the sounds acknowledged as negative by the workers, which may in turn contribute to an improved sound assessment in laboratory space.

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Speech transmission index in public address system design – a simplified method for central systems

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Principles for the design of public address systems to ensure adequate speech intelligibility are presented in the literature mainly based on the calculation of Articulation Loss of Consonants (ALcons). In Europe, the requirements are most often specified by the Speech Transmission Index (STI). This paper proposes a design method for central loudspeaker systems that makes it possible to achieve the desired speech transmission index values by designing a system that provides a sufficiently high sound signal level. The required signal level and the reverberation time limits of the soundproofed room can be read from the characteristics presented in the paper.

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Statistical analysis with Kolmogorov-Smirnov distance for reflections' directions of arrival and amplitudes for sound field diffuseness estimation

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Many parameters are used for rating the quality of the sound field inside qualified acoustic halls describing the strength, clarity, and definition of the sound. Sound field diffuseness level and spatial impression parameters are used rarely because of the problem in their measurements and interpretation. Previous research on that topic provided some sound field diffuseness coefficients. Some of them are complicated in estimation and measurement. This paper presents a method for the sound field diffuseness level estimation basing on example measurements of the Arthur Rubinstein Philharmonic in Łódź, Poland. New directional parameters are proposed based on the statistical analysis of the sound reflections' incidence angles and their amplitudes with Kolmogorov-Smirnov distance. The paper contains a discussion on the quality evaluation with the proposed method, including analysing the sound field diffuseness and non-uniform spatial distributions of sound reflections. The usability of the selected parameters and their importance for the spatial impression is discussed. The performed experiments allow setting the direction of future work in the field taken of the study, especially applying the proposed method for extended sound field diffuseness ratings with methods based on different physical principles, including directional, energetic, and time coefficients.

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Stopband effect and sound transmission loss of periodic locally resonant structures

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This paper investigates the theoretical aspects of sound attenuation of periodic structures with locally resonant elements. The stopband effect in frequency characteristics of infinite periodic structures created by the resonant elements is investigated. The dispersion curves calculation procedure is described in details with the influence of resonance frequency and mass of added locally resonant structure on width of the obtained stopband is investigated. The theoretical formulation for calculation of the sound transmission loss for periodic structure is derived. The performance of the structure with locally resonant elements is evaluated based on dispersion curves obtained for an infinite periodic structure and transmission loss calculated for finite structure is conducted.

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System modifying the acoustic properties of room furnishings

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The article presents an idea how to improve the acoustics of an interior without significantly interfering with its appearance and architectural character. Based on scale model tests, analytical calculations and computer simulations, it has been shown that a noticeable improvement in the room acoustic parameters can be achieved by installing additional absorbing systems on selected furniture surfaces. By selecting the appropriate design and location of such systems, the functionality and appearance of the modified furniture can be maintained.

* * *

The effect of prior distribution for estimation of sound power level by the engineering method

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In the in-situ conditions use of the precision method according to ISO 3745:2012 to determination of sound power level it is not possible. Therefore in the industrial conditions is used among others engineering method according to ISO 3744:2010. For the reasons mentioned above, it seems to be necessary to implement solutions of nonparametric statistics to increase the accuracy of determining sound power level of industrial devices in the in-situ conditions. Particular attention was paid to the possibility of using the Bayesian inference. The possibility of using the Bayes' theorem to determining sound power level in the industrial conditions was presented in this paper. This experiment served to determine the impact of prior distribution on the accuracy of sound power level estimation. The results of the simulation experiment were compared with the

results of the sound power level determined using the precision method in the hemi-anechoic room according to ISO 3745:2012. The inference has been carried out based on results of non-parametric statistical tests at significance level $\alpha = 0.05$.

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The impact of the sound reflection model on the ray tracing simulation variability

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Geometrical acoustics is the most commonly used method of room acoustics prediction. Its efficiency can be improved by explicit calculation of ray contribution to each receiver during reflection called algebraic reflection. The aim of this research is to analyse the applicability and impact of reflection model choice on algebraic reflection calculation using the ray tracing with next event estimation. The tested reflection models include the specular and Lambert reflection combination and the Phong reflection model. Classical ray tracing algorithm, without algebraic reflections, is used as a reference. Based on simulation results and statistical analysis we conclude that the change of the reflection model significantly affects the acoustics conditions within the simulation changing echograms in early reflections region and the reverberation times. Statistical analysis proved that echograms obtained with the combination of ray tracing with next event estimation and Phong reflection model have lowest simulation to simulation variability.

* * *

The influence of magnetic fields on acoustic properties of magnetic dispersions and emulsions

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Dispersions of magnetic particles in liquids (i.e., magnetic fluids) and emulsions stabilized with magnetic particles (i.e., Pickering emulsions) have been offered numerous potential applications when being exposed to external magnetic fields. When an alternating magnetic field is applied, the particles become the sources of heat due to magnetic relaxation and magnetic hysteresis that can be used e.g., in magnetic hyperthermia therapies. On the other hand, magnetic particles are responsive to the static magnetic field and can change their position or form the larger structures that, as a results, lead to the process of magnetic separation. In the presentation, we will present how the heating under the alternating magnetic field influenced the acoustic properties of magnetic fluids, magnetic Pickering emulsions, and the dispersions of magnetic and soft particles. In addition, ultrasound was used to evaluate the efficiency of the Pickering droplets separation under static gradient magnetic fields of different intensities. Based on the changes in the ultrasonic attenuation the dynamics of droplet movement was characterized as well as the efficiency of purification of the emulsion continuous phase. The obtained results can contribute to non-destructive methods of assessing the efficiency of magnetic separation process.

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The influence of noise in the workspace on soundscape perception in break rooms

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This article presents the results of studies on noise in the workspace and in rooms intended for rest during work. Based on the conducted studies, a comparison of the A-weighted sound levels in selected employee break rooms and the A-weighted sound levels present during the performance of specific tasks was carried out, with a calculated noise exposure level relative to an 8-hour daily work schedule. The soundscapes of break rooms in four locations were studied. The acoustic conditions found in employee break rooms were determined, and the requirements concerning the acoustic environment present in a break room were identified.

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The short sounds. Behavioural studies and artificial head's measurements

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In the speech short sounds with a duration time less than 20 ms will be presented. The Weber Fechner Law states that the just perceptible difference of two stimuli is proportional to the intensity of the stimuli themselves. This implies a logarithmic dependence of the sensation on the stimulus intensity. In our case, it corresponds to the just perceptible difference (DL) in the duration time being proportional to the duration of the pulse. The sounds are only Gaussian envelopes and may be distinguished by the sensation of the pitch or the timbre. In principle it is not possible to determine simultaneously the pitch and the duration time because of the limitations imposed by uncertainty principle. The sounds were played to the participants during Difference Limen behavioural test (DL). To compare the response with the physiology of the sounds, the sounds were recorded by artificial head with headphones in an anechoic chamber. Having collected the spectra for all the sounds with different duration time the minimal change of sigma that ensures the corresponding shift of the spectrum's expectation value by K standard deviations has been calculated. The constant K fitted to the behavioural data. The model of perception of the effective pitch will be presented.

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The use of optimization in the design of loudspeakers with special characteristics – a cardioid subwoofer

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In the search for parameters of devices with specific properties, optimization methods are often used to determine a set of parameters that describe the potential best solution while satisfying the imposed constraints. This paper presents the results obtained by applying Multi-Objective Particle Swarm Optimization (MOPSO) to determining the dimensions of the elements of a subwoofer with the directivity pattern close to the cardioid. This approach was validated by making a prototype of a device that was measured. The distinctive feature of the subwoofer is that it can be driven by only one channel of the amplifier and does not require signal processing such as delay or phase correction. The design is based on two speakers connected in parallel and a combination of bass reflex and bandpass enclosures, which provide the required phase shift of the signal.

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The use of Tranquility Rating for urban spaces

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The Tranquility Rating coefficient (TR) is a tool proposed for assessing the quality of urban green areas, which considers both visual and acoustic aspects. This paper aims to verify how the proposed TR coefficient works for the assessment of the audio-visual quality of a typical urban space in a vicinity of an arterial road. Three different versions of the same urban space are considered: loud and visually unappealing (current state), quiet and visually unappealing (after considerable traffic reduction), and visually appealing and quiet (after redesigning). The values of noise levels required for the calculation of TR are taken from the noise maps based on the in-situ measurements, and the values of the percentage ratio of the features which are natural or man-made but contained within the visual scene (NCF) are taken from a survey conducted in the research. The results show that for the urban areas, even with very low noise levels, the TR is described as "unacceptable". This may indicate the need for introducing an amendment for TR to be used in typical urban areas.

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Thinning of microphone array in near-field broadband beamformers

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This paper is devoted to the problem of designing an optimal microphone matrix. We define a criterion function where the performance of our matrix should be as close as possible to desired one based on L2 norm. In the classical approach, increasing a size of the matrix is used to improve the system performance. However, in many cases it is not a good solution. In this paper we propose a solution based on thinning technique. We work with square, equispaced microphone matrix and using metaheuristic approach called simulated annealing we optimise the set of active microphones (we switch off some of the microphones from the regular matrix). For illustrations, few numerical examples are solved. Comparing to the classical approach we show that thinning microphone matrix can significantly improve system performance.

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Transient states analysis of automotive component using 3D sound intensity measurements

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The modern automotive industry invests more and more in electric drive technology. As a result, new challenges arise in terms of vibroacoustic optimization of the car interior. Components that were once masked by the internal combustion engine are starting to dominate the interior of vehicles. There is therefore a great need for noise reduction. For this purpose, a number of methods of its reduction are used, i.e. component optimization (source), use of active noise reduction systems or passive soundproofing materials. In order to perform the abovementioned noise reduction measures, appropriate measurements and signal analysis should be carried out. This presentation aims to present the measurement of an automotive air cooler in transient states on the stand. Measurements were made using a 3D intensity probe based on the direct measurement of the acoustic particle velocity, in 3 planes in front of the cooler. Then, order tracking analysis was performed for the run-up and coast-down. The results in the form of selected orders of intensity and acoustic particle velocity were compared with classical results made with the use of a microphone at the same measurement points locations.

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Ultrasound-triggered cargo release from capsules

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Capsules with shells composed of fused microparticles receive increasing recognition for advantageous properties and various applications. Well-designed capsules should ensure safe cargo delivery and facilitate its controlled release on demand. The ultrasonic method was proposed for the controllable and unidirectional release of the encapsulated substance. We demonstrated that plane ultrasonic waves with low-intensity and high frequency can act as a trigger for the smooth liberation of liquid cargo. The ultrasound-induced puncture of the shell was followed by unidirectional and controlled release of encapsulated payload. In the case of Janus capsules, also different mechanical properties of two shell regions influenced the course of the liberation process.

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Underwater acoustic communication system using broadband signal with hyperbolically modulated frequency

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The implementation of reliable acoustic underwater communication in shallow waters is a scientific and engineering challenge, mainly due to the permanent occurrence of the multipath phenomenon. The article presents the concept of a transmission system using a broadband signal with hyperbolically modulated frequency (HFM) to transmit data symbols and synchronize data frames. The simulation tests were carried out in channels with Rician fading, which reflect the short and medium range shallow water channels. The simulation also took into account the presence of additive Gaussian noise in the channel and the influence of the Doppler effect was determined. The obtained results prove the high reliability of the underwater communication system based on broadband HFM signals.

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Usefulness of the matching pursuit method in phonocardiographic signal analysis

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This paper presents a phonocardiographic signal analysis with special emphasis on the Matching Pursuit method. To the knowledge of the authors, this method has not been used before to analyze PCG (phonocardiogram) signals. For this reason, its usefulness for this signal type was tested and a dictionary of Gabor atoms was created. Based on these findings, PCG signal analysis was performed as a Wigner-Ville distribution and compared with a spectrogram. Observing the obtained graphs, it was found that the Wigner-Ville map gives more detailed information about the frequencies which make up the given signal and the time of their occurrence. This method can be used to detect anomalies and pathologies of the heart.

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Using free FEM open software for modelling the vibrations of piezoelectric devices

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Modelling vibrations of piezoelectric transducers has been a topic discussed in the literature for many decades. The first models – so-called one-dimensional – describes the vibrations only near operating frequency and near its harmonics. Attempts to introduce two-dimensional models were related to the possibility of one transducer working at several frequencies, including both thickness vibrations and those resulting from the transducer horizontal dimensions. In recent decades, thanks to the use of the finite element method and its derivatives, and the progress related to the increase in processor speed and memory availability, the implementation of models based on three-dimensional modeling is possible using software on personal computers. As the implementation of finite element method algorithms is characterized by high complexity, several professional software packages have been created on the commercial market, among which only a few implement the piezoelectric equations. In this context, this article presents how to use open source software along with developed programming language for intuitive definition of piezoelectric equations and its solution.

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Using MLS method in laboratory measurement of airborne sound insulation

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Following the requirements of ISO 10140, to determine the acoustic insulation, measurements of the sound pressure levels in the transmitting (L_1) and receiving (L_2) rooms and the reverberation time measurements in the receiving room (T) should be performed. However, the standard does not indicate the measuring signal to be used for the measurements. Various measurement methods can be used, including the use of the Broadband noise or MLS method. The article examines the influence of the applied measurement methodology on the determined spectra of acoustic insulation and the weighted sound reduction index R_w. The total uncertainty of determining the acoustic insulation properties and partial uncertainties in determining L_1, L_2, and T were also calculated. The analysis of the obtained results allows concluding that the applied measurement method has no significant impact on the obtained acoustic insulation values, and the obtained measurement differences may rather be the result of an insufficient sample size.

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Variable interpretation of the intonation process and the acoustic-physiological field in the vocal process of singers

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The basic goal of learning to sing is to acquire the skill of imperceptible sonic transition from the chest to the head register. One of the methods of classifying voices according to the degree of advancement is the analysis of the ascending and descending scale exercise, during which for untrained voices, in a certain range of sounds (transitional sounds) from the vocal scale, there is an uncertain intonation and a distinct timbre of these notes. The reason for this phenomenon is the following change in the vibrational mechanism of the vocal folds from the thoracic to the head (ascending scale) and vice versa (descending scale). Transitional sounds occur in the so-called registration thresholds and may change their range depending on the type of voice

and singing technique. Moreover, an untrained singer differs from a trained singer in terms of the diversity of the colour of the thoracic and head registers by changing it from dark to light after crossing the register threshold. The presented article presents the results of research on the method of generating sounds in registers, the vibration mechanism of the vocal folds, during correct and incorrect emission of sounds by singers.

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Verification of compliance with normative requirements concerning equipment and conditions of carrying out sound attenuation tests of hearing protectors

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The sound attenuation of hearing protectors is the basic parameter determining their attenuation properties. The information about sound attenuation values is essential for selection of hearing protectors. Based on the sound attenuation values and the noise parameters at the workplace, it is possible to calculate what the A-weighted sound pressure level will be under the hearing protectors. The sound attenuation of hearing protectors is determined in accordance with the requirements of PN-EN ISO 4869-1:2018-12, which replaced the PN-EN 24869-1:1999 standard that was in operation for many years. This standard specifies the requirements for the test equipment and the test site in which the sound attenuation of hearing protectors is measured. The paper presents measurements verifying that the requirements specified in PN EN ISO 4869-1:2018-12 are met by the test equipment used in CIOP-PIB and the cabin used for testing hearing protectors.

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Voice pathology assessment using x-vectors approach

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Voice pathology assessment using sustained vowels has proven to be effective and reliable. However, only a few studies regarding detection of pathological speech based on continuous speech are available. In this study we evaluate the usefulness of various regression models trained on continuous speech recordings from Saarbruecken Voice Database in the detection of voice pathologies. The recordings were used for extraction of speaker embeddings called x-vectors based on mel-frequency cepstral coefficients and gammatone frequency cepstral coefficients. Since the dataset used in this study is imbalanced, various over- and undersampling techniques were applied to the training set to ensure robustness of models' decision boundaries. The models were trained on both imbalanced and resampled training sets using 5-fold cross-validation. The best results were obtained for Multi Layer Perceptron trained on GFCC-based x-vectors, achieving accuracy of 0.8184, F1-score of 0.8212, and ROC AUC score of 0.8810 for the testing set.

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