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The 53-rd Open Seminar on Acoustics OSA'06

The conference is organized by the Division of the Polish Acoustical Society in Kraków and Department of Mechanics and Vibroacoustics at the Faculty of Mechanical Engineering and Robotics, AGH University of Science and Technology.

The conference will be devoted to different aspects of theoretical and experimental research in the field of acoustics. Eight invited papers will be delivered by the following speakers:

1. Dr hab. inż. Andrzej Dobrucki,
   Wrocław University of Technology, Wrocław;

2. Prof. dr hab. inż. Zbigniew Engel,
   AGH University of Science and Technology, Kraków;

3. Dr hab. inż. Grażyna Grelowska,
   Naval University of Gdynia, Gdynia;

4. Prof. dr hab. inż. Jan Kaźmierczak,
   Silesian University of Technology, Gliwice;

5. Dr hab. Piotr Kleczkowski,
   AGH University of Science and Technology, Kraków;

6. Prof. dr. hab. inż. Tadeusz Powałowski,
   Institute of Fundamental Technological Research, Warszawa;

7. Dr hab. Anna Preiss,
   Adam Mickiewicz University, Poznań;

8. Dr hab. inż. Stefan Weyna,
   Szczecin University of Technology, Szczecin.

The 11 contributed sessions are planed. There are 131 contributing papers which will be presented during the meeting.

Organizing Committee

Jerzy Wiciak – Chairman   *Andrzej Uchryński* – member

Invited Papers

1. Modern technologies in hearing aids

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The subjects of the paper are modern hearing aids. Most of them are based on digital signal processing. This allows for programming of the parameters and characteristics. The hearing aid can be fitted optimally to each hearing impairment. The hearing aids can also contain the systems of noise reduction and feedback cancellation, and they can be miniaturized. Modern hearing aids are also strongly nonlinear. The rules of hearing aids fitting as well as technologies of cochlear implants are presented in the paper.

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2. Inverse method in acoustics

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Inverse methods in the wide sense have been developed by people working in many scientific branches, for example: geophysics, medical tomography, earthquake location, satellite navigation, acoustics. Inverse problems occur in a wide range of acoustically related disciplines ranging from aeroacoustics and ultrasonics to ocean acoustics and vibroacoustics.

The paper presents a draft of inverse theory of several applications in vibroacoustics, particulary sound sources reconstruction and problems of regularization.

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3. Acoustics and the sea

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The depths of the seas and the oceans are considerably less explored than the land areas of the Earth. The cause of this situation is the difficulty in observation of underwater world. The methods using the electromagnetic waves are mostly ineffective in water environment.

The acoustic waves are the basic carrier of information about water environment. However, their propagation in water is fundamentally dependent on current physical proprieties of the medium, and especially on the distribution of the fields of temperature and salinity, on the contents of gas blisters as well as scatterers in the form of microorganisms or suspension.

Moreover, the way of propagation of the acoustic waves in water depends on scattering and dispersive properties of the seabed as well as on the state of sea. In case of longer observation, the conditions of propagation can be modified by macro-, mezzo- or micro-scale phenomena that cause mutual displacement of the water masses having different physical characteristics.

Changeability and complexity of conditions of propagation of acoustic waves enlarges the degree of difficulty of under-water exploration and requires clear-sighted analysis during interpretation of results of the measurements.

The methods of underwater observation considering the way of obtaining the information are divided into two basic groups, active and passive methods.

Active method includes all kinds of sonars, echo sounders and equipment for underwater navigation and communication. They are used for detection and localization of underwater objects as well as for determination of their properties based on characteristics of signals that are sent and their echo.

To the second group of equipment belongs to the so-called devices of the underwater observation, in which the knowledge on acoustic characteristics of the environment and their variables is gained by analyzing the received signals. In this way they can provide the knowledge about appearance of the new objects. In both groups more and more advanced techniques of forming the acoustic beams and methods of signal processing are developed. The actual tendencies in the technology of underwater research and the applied solutions that are used in hydroacoustic equipment and systems are presented in the paper.

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4. GIS-class systems of spatial information as the base of creating strategic acoustic maps of urban areas

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This paper is focused on problems of creating strategic acoustic maps of towns according to requirements of the European Noise Directive 2002/49 as well as to the Polish legislation, concerned with the mentioned directive. Authors of the paper represent a consortium of R&D units established in 2003 for the needs of realization of target-oriented research project No 6T07 2002/C.05779 "Development of System of Creating and Exploiting of Digital Acoustic Maps of Big and Medium Size Towns for the needs of Professional Spatial Planning and Schooling of Administrative Personnel", co-financed by the Polish State Committee for Scientific Research. It is the key assumption of the project that the acoustic maps of the town will be created as autonomous layers in GIS-class systems used now for various purposes in majority of City Halls in Poland. The paper shows the run as well as the current state of realization of the research project in their three basic aspects: aspect of processing mapped information, aspect of "pure acoustics" and aspect of the managing the complex research project. In particular, the successive stages of schedule of the introduced project are presented in the paper as well as some conclusions from the closed stages. The concept of using the so-called "maps of processes" for the needs of management of activities concerned with creation and exploitation of strategic acoustic maps of towns by their administrations is introduced in the paper, too. This technique can supply both the effective realization of utilitarian part of the research project and further realization of the implementing-educational phase, which should contain necessary schooling of City Hall personnel and necessary expert support.

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5. The phenomena of one sound obscuring another

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The structure of the signals received by the human ear and by the human eye is different. The ear receives the sum of signals from individual sound sources. The eye receives full information only from the object which is closest to it (in a particular direction) and objects behind that object are obscured. An interesting psychoacoustic phenomenon has been discovered: when the structure of the signals received by the ear is made similar to the structure of the signals received by the eye, the ear perceives very little difference. The appropriate processing of the acoustic signals is performed in the time-frequency plane. This phenomenon may be applied in audio engineering. With some advanced processing, an improvement in the sound of mixes may be obtained.

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6. Ultrasonic examinations of human arterial walls

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Contemporary ultrasonic methods used in examinations of the arterial walls, focus on determination of the changes in the local arterial wall stiffness and thickness resulting from the age and vascular disease, including atherosclerosis. The paper presents an overview of the results of arterial wall examinations obtained by means of different ultrasonic techniques such as: ultrasonic image analysis of the artery, echo tracking technique and local pulse wave velocity examinations. Comparative studies were carried out for the control group of the healthy persons, for the group with risk factors of atherosclerosis and for the group with carotid atherosclerosis.

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7. Environmental acoustics and the auditory science

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The ultimate function of an auditory system does not consist in processing environmental sounds which affect auditory organs. It is the information about the objects in the outer world that is of a vital importance for an organism fighting to survive. This information can be also obtained by an auditory system. This system collects sounds because it uses them as the sources of important information of what is happening out there. The acoustic events are not processed to detect the physical parameters of sounds but such properties as: the distance of the sound source, its velocity, direction of its movement, and even its size and weight. All these 'non-acoustic' characteristics of the sound source influence subject's annoyance judgments, and should be included in noise annoyance ratings. My talk will discuss how chosen non-acoustic characteristics of the sound source influence the annoyance ratings.

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8. Some comments about existing theory of sound with comparison to the results of experimental research of vector effects in real-live acoustic near fields

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Classical studies on the descriptions of acoustic field in an area of a near-field in accordance with the relation formulated by Kirchhoff integral, Huyghens integral formula or Rayleigh integral are commonly known. It is also known that typical inference phenomenon: diffraction and scattering of acoustic waves, appear in an acoustic field of the real sources as a result of mutual reactions of component waves. Today these vector effects of the acoustic wave occurring in the area of a near-field can be measured directly with the use of a sound intensity technique.

The article presents a few examples of application of the sound intensity technique to graphic presentation of spatial distribution of the acoustic power flow over various geometrical shapes of structures located in a three-dimensional half-space. The results of studies contribute to the theory of sound and general knowledge about the physics of flow acoustic phenomena, especially in the near acoustic field. As the results of research, the visualization analysis of the sound intensity flux in 3D-space is shown. The visualization of acoustic power flow in real-life acoustic fields can explain many particular energetic effects (scattering, vortex flow, shielding area, etc.), concerning the areas in which it is difficult to make numerical analysis.

Key words: theory of sound, wave flow, sound intensity.

Speech Acoustics

9. Experimental comparison between Speech Transmission Index (STI) and Mean Opinion Scores (MOS) in rooms

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In this paper two methods for assessment of speech quality in rooms were compared, the speech transmission index (STI) and the mean opinion scores (MOS). Subjective and objective measurements were carried out in two rooms for different signal-to-noise ratio within a range from -15 dBA to $+15$ dBA. The obtained results are shown as a curve describing the relation between a MOS, STI and signal-to-noise ratio (S/N). The obtained characteristics were compared with a curve given in other publications.

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10. Voice signals devices control based on the phonemes identification

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Controlled by the voice commands, although more and more popular in such devices as phones, cd-players etc., still meets different troubles. They are caused by differences between languages what makes impossible adopting the methods of speech recognition from one language to another, and differences in pronunciation of the people speaking the same language. This article describes a new method of speech recognition which was applied to control the self-moving robot. This method is based on the images recognition. These images are obtained from the voice time characteristics. The results of the research and of the planned tests are also described.

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11. Sine-wave windowed synthesis

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Speech can be understood even when a 3-tone replica of speech is presented to a listener. In tonal synthesis, called sine-wave synthesis (SWS), the output signal consists of three time-varying sinusoids that follow center frequencies and amplitudes of the first three formants of a natural utterance. In the paper we propose an alternative technique of speech synthesis. It is based on three dominant frequency components present in the original signal. In the proposed method, called sine-wave windowed synthesis (SWWS), the amplitudes and frequencies of tonal components are changed in discrete steps in subsequent time windows. Perceptual tests performed on Polish speech shows that signals synthesized by SWWS technique are judged as more natural and intelligible than the SWS speech.

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12. Contactless hearing aid designed for infants

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It is well known that language development through home intervention for a hearing-impaired infant should start in the early months of a newborn baby. In the paper, a concept of a contactless digital hearing aid designed for infants is presented. In contrast to the typical wearable hearing aid solutions (ITC, ITE, BTE), the device proposed is mounted in the infant's bed. Any part of the hearing aid set-up contacts the infant's body. Processed speech signal is emitted by the low-power loudspeakers placed near the infant's head. The hearing aid architecture employs a digital signal processor based on Texas Instruments technology. Since one of the main problems is related to acoustic feedback between the microphone and loudspeakers, therefore the methods for acoustic feedback elimination are reviewed briefly. One of the methods discussed employs an adaptive algorithm in order to prevent the feedback occurrence. The second one alters the frequency response of the entire instrumentation by employing the notch filter banks. The third approach incorporates microphone array and beam-forming techniques. In the paper some algorithmic solutions engineered by the authors to eliminate acoustic feedback are presented. Conclusions are derived, based on simulations of an experimental contactless hearing aid set-up.

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13. High quality speech code employing sines+noise+transients model

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A method of high quality wideband speech signal representation employing sines+transients+noise model is presented. A need for a wideband speech coding approach as well as various methods for analysis and synthesis of sines, residual and transient states of speech signal are discussed. A perceptual criterion is applied during encoding of sines amplitudes in order to reduce bandwidth requirements and preserve high quality of speech. Therefore, a psychoacoustic model devised for perceptual speech coding is presented. The experimental results reveal that the method for tonality estimation employed in psychoacoustic model has a significant impact on perceptual coding accuracy. Various methods for tonality estimation are presented and compared.

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14. Mel frequency cepstral coefficients of original speakers and their imitators

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The results of intra- and interspeaker distances between MFCC vectors obtained from speech samples of eight well-known Polish personalities and their imitations performed by cabaret entertainers are presented and discussed. The intraspeaker distances between MFCC vectors representing normal and disguised speech samples of 10 speakers are also presented. The analysis of the results of measurements indicated that utilizing the Euclidean distance between MFCC vectors, it is possible to differentiate the original speakers from the imitators. On the other hand, the MFCC vectors cannot be used to confirm speaker identity in case of voice disguise.

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**15. Investigation of speech perception for patients
with a cochlear implant supported with a hearing aid**

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The investigations were carried out for 5 listeners with a cochlear implant, 2 male and 3 female in age of 13–62 years. The deafness for 4 subjects was recognized as postlingual and for 1 – as perilingual. All listeners were using the hearing aid on the opposite ear to the implant. The speech intelligibility was determined in two cases: when transmission was only via the implant and when the hearing aid was also used. Additionally, the ability of discrimination of male and female voices was performed. The presentation of tests was conducted for three angles (0, -90 and $+90$) in relation to the listener's head for the levels equal to 5, 65 and 80 dB SPL. The Polish monosyllabic word tests (PRUSZEWICZ *et al.*) were applied. The improvement of the speech intelligibility was affirmed when the process of hearing via the implant was supported by a hearing aid. The particularly essential differences in the speech intelligibility as well as in the discrimination of male and female voices were observed for angles -90 and $+90$. The results obtained in the investigations show that acoustic compensation in the range of remaining audibility field in a great degree supports the electrical hearing.

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**16. Visual feedback based on expired CO_2 as a therapy method
for respiratory disturbances in stuttering**

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A new CO_2-based visual feedback therapy method (VF) for respiratory disturbances in stuttering was preliminarily assessed. Sound and expired CO_2 signals were registered in 12 stutterers and 12 fluent speakers during speaking without and with VF to control breathing as well as during rest respiration, before each of them. In stutterers, the end-tidal CO_2 ($ETCO_2$), the area under CO_2/a time curve (SCO_2) and the average emission CO_2 ($ECO_2 = SCO_2/t_{breath\_cycle}$) for the CO_2 peaks connected with the phrases containing tonic errors (with reference to rest respiration), were higher than those connected with fluent phrases of utterances ($p < 0.000001$). Thus a tendency to hypoventilation caused by tonic errors was observed. The factors of breath ergonomics during speaking FE (based on both signals) in stutterers were

lower than those in fluent speakers ($p < 0.001$). Using VF by stutterers increased FE ($p < 0.01$) and decreased stuttering intensity.

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17. Influence of specific VoIP transmission conditions on speaker recognition problem

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The paper presents the problem of signal degradation in packet-based voice transmission and its influence on the voice recognition correctness. Internet is evolving into a universal communication network which carries all types of traffic including data, video and voice. Among them the Internet telephony, namely VoIP, is going to be an application of a great importance and it is why it is so important to assess how specific conditions and distortions of the Internet transmission (speech coding and most of all, packet loss and delay) can influence the speaker recognition problem. The Gaussian Mixture Models classification, the feature extraction, the Internet speech transmission standards and signal degradation methodology applied in tested system were overviewed. The experiments carried out for two most commonly applied encoders (G.711 and G.723) and three network conditions (poor, average and with no packet loss) revealed a minor significance of packet loss problem in the tested text-dependent system.

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18. Computer recognition of speech disfluency

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The aim of the research carried out by the author of the present work is to prepare a programme algorithm for automatic recognition of various types of speech disfluencies in stuttering people's utterances, on the basis of their parameterised characteristics in the amplitude-frequency space. It was for this aim that the disfluencies were classified according to similarities of acoustic features, which, after proper parameterisation, constitute the basis for their automatic recognition. In utterances of stuttering people there occur many disfluencies which vary in terms of their characteristics and duration times. Among them, some groups may be singled out which have similar acoustic features. Computer procedures have been elaborated for detection of disfluencies all of this kind. They allow from 70% to over 90% exactness of recognition of these episodes in continuous speech.

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19. The application of kohonen and multilayer perceptron networks in the speech nonfluency analysis

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Artificial neural networks were checked on their ability to categorize non-fluent and fluent utterance samples. The examined material were 40 4-second fragments containing disfluency rest on a blockade before words, starting with stop consonants (p, b, t, d, k and g) and including from 1 to 11 stop consonant

repetitions and 40 recordings of the speech of fluent speakers containing the same fragments, which were also cut to 4 seconds. We applied two various networks. The first, SOM, with 21 inputs and 25 neurons in output layer, was used to reduce the dimension describing the input signals. As a result of the analysis, we achieved vectors consisting of the neurons winning in a particular time point. These vectors were taken as an input for the next network that was MLP. Its various types: with one and two hidden layers, different kinds (back propagation and conjugate gradient descent) and time of learning were examined to determine whether they could correctly classify those utterances into two, non-fluent and fluent, groups.

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20. Confronting representative spectral structures of vocal tract pulse responses

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This article is a part of the series of OSA publications and covers the problem of how to formally classify the lexemes of different languages. Before the resources of a number of ethnic language systems can be confronted, multiple linguistic procedures must be applied to identify a possible acoustic common ground in the utterances of language users. Because of the clear differentiation in how speech sounds are articulated in different languages, we must establish the similarities in the concealed fragments of free speech responsible for giving the information code (the meaning) rather than in the acoustic representation of free speech. The paper discusses the methods and results of automatic classification of selected lexemes of three language systems by confronting their digital representations. The idea of digital representation was described in previous OSA publications as packages of acoustic parameters which the authors termed as: *representative spectral structures of vocal tract pulse responses. Representative...*, were produced using cepstral smoothing of averaged acoustic parameters taken from a number of utterances by speakers of different ages and gender. The publication gives the spectrograms of the material used for the confrontation and the results in graphic form.

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21. Selected methods of analysis of pathological speech signal

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This paper presents a review of acoustical methods for analysis and classification of deformed speech acoustical signal. The analysis of usefulness of these methods in medical diagnostics is also presents in the paper. The acoustical speech signal deformed by particular pathologies of a vocal tract is the subject of research.

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22. Analysis of determination methods of fundamental frequency

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Pitch, understood as the fundamental frequency of voice (F0), is one of the most important features in research field of human speech. It is supposed that knowledge of acoustic parameters determined from

F0 course of larynx vibrations contains valuable and important information about individual trait, and the physical and emotional state of the speaker. It is also possible to perform both quantitative and qualitative analysis of the speech deformation, as connected with damages of larynx. At present, the digital methods of registration and processing speech signals enable to produce a number of different algorithms for the pitch determination. It still remains one of the most difficult problems in the field of signal speech analysis. In the present paper, a selected determination methods of F0 are presented and compared. Authors focused on the zero-crossing analysis, cepstrum method and pitch determination algorithm, based on subharmonic-to-harmonic ratio.

Biomedical Acoustics

23. Vibration measurements of the human skill using laser Doppler vibrometer

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In the paper the results of vibration measurements of a human dry skull preparation are presented. The skull was exited by bone conduction receiver, whereas measurements were done using scanning laser Doppler vibrometer (SLDV). SLDV allowed precise investigations of even very light parts of nasal bones. Vibrations of the skull have been analyzed in 3D as a combination of five perpendicular section views. It has been shown that at frequencies below 1 kHz, the vibrations occur mostly in the frontal part of the skull, near nasal sinuses, whereas parietal, temporal and occipital bones vibrate at higher frequencies. Moreover, high amplitude vibrations of the facial part, temporal and mastoid bones have been observed near the frequency 2 kHz. An explanation attempt of meaning of the nasal sinuses in the context of different medical theories was carried out.

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24. Application of an ultrasonic method in cryosurgery

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The aim of the study was to evaluate the applicability of an ultrasonic method to monitor cryosurgery procedures. Results of ultrasonic studies indicate the possibility to observe changes in the structure, shape and size of the ice ball in the frozen tissue.

An ultrasonograph was equipped with 9 MHz linear transducer with penetration depth equal to 3 cm. Parameters of the transducer allow to control the progress of a cryosurgery treatment in terms of an ultrasonographic image. Pathologically altered tissue was subjected to liquid nitrogen. The ultrasonographic image of the frozen tissue appears as a sphere- shaped luminous area. The frozen zone ("ice ball") is a medium strongly attenuating the ultrasound.

Ultrasonic investigations during cryosurgery procedures were performed in patients with common warts and seborrheic warts as well as in experimental media.

It was proved that the applied ultrasonic method was useful for estimation of the size of the dermal alterations connected with nipples, the size of the ice ball and to control the refreezing process.

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25. Ultrasonic examination of tongue shape changes
in the process of articulation of speech vowels

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The paper presents the results of ultrasonic examination of tongue shape changes in the process of articulation of vowels by people articulating correctly (without pronunciation disorders). What was examined was the position of the tongue while pronouncing a definite vowel and the influence of individual anatomical differences upon the tongue shape. The results were presented as ultrasonograms obtained in the B- and TM-type presentations. The presentation in the TM mode enables, among others, determining the deflection amplitude during articulation of a point on the tongue surface that is the most change-prone at a given distance from the hyoid bone. The obtained results were used for building a tongue phantom and for constructing a mechanical setup changing the phantom shape. The proposed setup is the basis for constructing a system representing natural tongue motions during articulation that can be used as a major tool in deaf people's therapy, therapy of people with hearing disorders as well as of people with pronunciation disorders.

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26. Changes low frequency sound impacts
on the fractal dimension of EEG signal

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The paper outlines the methodology and summarizes the results of experimental program of investigating the impacts of infrasound at frequency $f = 40$ Hz and the acoustic pressure level $Spl = 110$ dB (HP) on the fractal dimension of EEG signals. The test group included 33 participants.

The effects of infrasound exposure were assessed using the fractal analysis of EEG signals. The Higuchi algorithm is applied. EEG signals are represented in the time domain as a pattern of HFD (Higuchi Fractal Dimension) variations for short time windows.

The statistical analysis of variations of the mean HFD of EEG signals at all stages of the experiment for all channels reveals that the mean HFD value during the exposure for the tested population is larger than the mean value reported at the stage with no infrasound exposure.

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27. The acoustic pulse technique and cross-correlation algorithm
in viscoelastic properties of gel phantoms investigation

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Mechanical properties of soft tissues play an important role in the detection and treatment of many solid tumours. The common method of hard tumours detection is the standard palpation, but this method is

limited only to those parts of the body which are accessible to the physician's hand and is not a quantitative method. Sonoelastography and MR elastography has found numerous applications in medical diagnostics for identification of tumours, the rigidity of which differs markedly from that of the surrounding healthy tissues. These methods mainly use the low-frequency shear waves as an information carrier and allow for imaging of the shear modulus distribution which is an important medical diagnostic quantity. In the present report an acoustic pulse technique is proposed to obtain the viscoelastic properties of tissue simulating phantoms. This method use the cross-correlation algorithm for determination of the local displacement of medium scatterers.

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28. Some method of measurement of cochlear potentials evoked by two-tone excitation

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A new method of cochlear potential measurements has been presented. The method can be used when the potentials are evoked by two-tone acoustic wave. Fundamental for the method is the phase-sensitive detection technique. Experimental results obtained by using this method has been presented, too.

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29. New algorithm for ultrasonic estimation of blood hematocrit

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The method is based on measuring the power of the Doppler signal backscattered by blood cells in the human brachial artery. The hematocrit HCT value is estimated from ultrasonic attenuation coefficient calculated from the power of Doppler signal. In this work, new averaging methods are proposed, that fully exploit the multigate capabilities of the ultrasonic system, by evaluating the attenuation using information from multiple gates. These approaches proved to be suitable for in-vitro and in-vivo measurements. The in-vivo measurements were performed in 46 patients with HCT ranging from 32.0% to 49.3%. The experiments presented a good agreement with the value of blood hematocrit measured invasively, reporting a mean absolute error of 3.50% with a standard deviation of 2.71%, with a difference against the mean value within the mean $\pm 1.96\%$ standard deviation. The proposed method appears to be promising for in-vivo determination of hematocrit, preferred for monitoring changes of hematocrit in patients in traumatic shock or during dialysis.

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30. Modal analysis of the human tympanic membrane of middle ear using the finite-element method

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This paper provides a theoretical vibration model of a tympanic membrane constructed and solved using the finite-element method. This method is an appropriate tool to analyze the middle-ear vibrations

because it enables modeling in details the complicated shape of the middle-ear and, moreover, allows to calculate the distribution of vibrations stimulated by sinusoidal signals. The number of the tetrahedral elements was assumed to be 253 and material properties used are based on data available in the literature. This model has a uniform density of $1.2*10^3$ kg/m^3, an area of 70 mm^2, a depth of $1.54*10^{-3}$ m at the umbo, a mean thickness of $1.32*10^{-4}$ m, and Poisson's ratio 0.3. Constrains were accomplished by two different springs, linear and torsional. The results obtained are compared with their counterparts scattered in the literature.

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31. Modeling and ultrasonic examination of common carotid artery thickness changes

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The paper is aimed at presenting the results of numerical analysis of the plane strain in the model of the wall of a human common carotid artery. The results obtained were compared with the experimental data resulting from the ultrasonic measurements of variation of the wall thickness of the common carotid artery. Ultrasonic measurements were made on a 34 y.o. man using the VED apparatus developed by the authors for evaluation of elasticity of the arteries. The numerical analysis was done by means of the Finite Element Method (FEM) implemented in an environment of MARC K7 program (Analysis Research Corporation) under the UNIX operating system. As a model of the common carotid artery was assumed a hollow cylinder made of isotropic, almost non-compresible material, with the Poisson ratio $\nu = 0.499$ and the Young modulus $E = 222$ kPa, intima media thickness $h = 0.52$mm and a homogenous structure. Modeling of the plane strain concerned the effect of blood pressure growth by 42 mm Hg. Results of the computer analysis of the strains in the common carotid artery were compared with the results obtained by ultrasonic examination.

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32. Golay complementary codes, double prf transmission

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This study concerns the development and investigation of a new composing method of short coded sequences and their transmission, based on well-known Golay complementary codes and applied compression technique allowing to increase the signal-to-noise ratio (SNR) and penetration. This new method can potentially play an important role in examination of superficial structures, e.g. dermatology, ophthalmology, etc. This paper reports the results of examination of the two pairs 3.5 MHz coded sequences of the same duration: the single 32-bits pair Golay sequences and combined sequences consisting of two 16-bits Golay codes separated in time. The results clearly demonstrate the potential of the combined coded transmission obtaining the $\text{SNR} = 22.6$ dB that is 2.6 dB higher than that for the traditional Golay sequences and it is in the case when coded length is two times shorter. For obtaining the same SNR using traditional method the code length should be at least 64 bits long, resulting in the increased dead zone up to 1.4 cm.

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33. The impact of 19-day low-frequency vibration "training"
on basic physiological parameters of human organism

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The reports on potential applications of low-frequency vibrations in therapy are rather scarce. Therefore, scientists decided to carry out a 19-day long experiment, in order to check the low-frequency vibration "training" on selected physiological parameters of human organism. The experiment was carried at the Academy of Mining and Metallurgy in Cracow from September 15, 2003 till October 15, 2003. In order to evoke the cyclic changes of bone load, the harmonic vibration of 3.5 Hz frequency and 4 mm amplitude was suggested. It was assumed that the vibration was safe and not annoying. The results underwent the statistic analysis using the Statistica 7.1 program.

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34. Scattering of ultrasonic waves on a model of the artery

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The aim of this paper is creation of a mathematical model for describing the process of propagation of the acoustic wave, generated by an ultrasonic probe in the inhomogeneous dissipative medium. The modeling process included a phenomenon of scattering of a focused ultrasonic beam. During modeling we have considered a segment of a hollow cylinder with material parameters close to the biological material of the artery. The cylindrical model of the artery was changing the radius and thickness of the wall under cyclic variation of blood pressure. The numerical solver was created for calculation of the fields of ultrasonic beams and scattered fields under different boundary conditions and different angles of penetration of ultrasonic beams with respect to the position of the arterial wall. The result of numerical calculation was the shape of the electric signal detected by the ultrasonic probe as a result of the ultrasonic beams scattered on the model of the artery. That signal was the basis for computing simulation of the tracking process of instantaneous artery diameter changes under the assumed radial strain.

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35. Estimating the efficiency of surgical treatment
of the polyp of the larynx by the acoustic method

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If one wants to measure the efficiency of the surgical treatment of the polyp of the larynx, it is important to consider the quality of the speech signal in patients under treatment. Advised treatment should depend on the test results and the voice acoustic estimation after the surgical procedure. Although it is possible to estimate the quality of the voice subjectively, objective methods are much more effective as there is room for comparison and verification. The aim of this project is to present the survey results concerning the possible usage of modern technologies of acoustic signal transformation. It is also aimed at indicating the reasons of possible failure. The acoustic method of estimating the patients speech deformation was introduced in this research. Thanks to the data which were collected from a few surgically treated patients,

we have managed to gain dynamic spectrums and average dynamic spectrums. The basis of the analysis was the vector of symbols consisting of spectral moments and relative power coefficients. Eight metrics were used in patients examination. That number made it possible to verify them as far as their usefulness to the problem is concerned. The research was carried out a few vowels with the same aim. The metrics of Jeffreys–Matusis and Hamming are the best ways of differentiating the data. Moreover they present a clear picture, thanks to which it is possible to get all the necessary information in a short time.

Acoustics of Environment

36. Uncertainty analysis for long-term noise rate estimation

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The work concentrates on the analysis of long-term noise index estimation based on sampled-noise measurement. The assessment of estimation variability with the day of the week is made for the day-evening-night noise LDEN.

Two hypotheses were verified: one of identity of mean values of the estimates in different days of the week and the other of homogeneity of variances of the estimates calculated. The basis for the statistical calculations were annual data from the noise level monitoring system in Kraków.

The paper presens also a preliminary analysis related to the impact of the choice of estimator of the analyzed index LDEN on the uncertainty of estimation.

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37. Acoustical data gathering, updating and distribution system
– road noise module as an example of design methodology for database systems

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The article presents the design and building process of a database system constructed for a particular task. Its main subject is the database and all the relations which will take place among the gathered data collections and which result from the project assumptions. The database and the above mentioned relations are the integral part of the Acoustical Data Gathering, Updating and Distribution System, which is supposed to automate the measuring process and keep the gathered data coherent throughout the time. The article's subject is narrowed only to one module – Road Noise Module. In the summary, further directions of research are pointed out.

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38. Management of environmental noise on Kraków based example – creating information layers

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The aim of this article is describing the management of environmental noise system. The main part of the system are information layers, which have been made on the basis of SoundPlan, Integrated Noise

Model, MapInfo and GRASS programs. The layers present maps of noise emitted by: road traffic, rail traffic, industrial activity sites and airport Kraków–Balice. The strategic noise map were performed according to claims on Directive of the European Parliament and of the Council of the European Union and National Law Acts. The system is working on available measurement data. Many groups of experts are working on noise control. It is impossible to eliminate environmental noise, so it is necessary to make appropriate decisions. The aim of those decisions is to reduce the number of noise the exposed people. When decisions are made, the problem is to get right information about the sources, levels of each source, number of people living in a given area, results of noise protection works. In order to carry out acoustic climate control, we have decided to use the proven spatial information system technology (GIS), where phenomena that take place in environment are relatively easy to illustrate. This article describe such system which consists of two parts: datebase and presentation. The system will be based on numerous constant and variable symptoms maintaining correct and even comfortable acoustic climate conditions on the maximally largest area of the town, urban agglomeration or commune.

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39. Principle of relative superposition in designing and researching acoustic mufflers

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The paper presents other results of research work concerning the method of modeling acoustic properties of chimney installations, ventilation and similar. It is assumed that effective noise emitted at the outlet of this kind of acoustic systems may be reduced by superposition of the suppressing, absorbing and reflecting elements. The work is aimed at formulating the principles of proper selection and connection of such elements. A simple and effective measuring method is presented, defining the assumptions for further research work.

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40. An influence of wall structure on acoustic pressure distribution in operator's cab

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Acoustic conditions in operator's cab might be formed by means of parameters describing the cab walls. It might be realized by changing properties of cab sheathing. This paper presents the results of simulations which aimed at investigating acoustic conditions in operator's cab under change of cabin wall properties.

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41. Noises in selected Slovakian open pit mines

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There are many sources of noise related to exploitation of mineral deposits in open pit mines. Depending on the applied technology of open pit exploitation of mineral deposits, various machines and

equipment are used, as well as blasting techniques are utilized. There are two types of noises in open pit mines: continuous noises – emitted by machines and equipment and short-lived noises (impulse noises) – accompanying blasting works. Levels of noises, especially impulse noises, often exceed the permissible values. It causes large troubles for surroundings occupants and for natural environment, and also for operators of technological equipments. Problems of vibro-acoustic hazards in an environment – caused by open pit mines of mineral raw materials – were presented in the paper. The assessment of impulse-noise hazard performed in one of open pit mines was done in paper. Selected acoustical research of continuous noise emitted by machines and equipment in a few mines were presented. Occupational risk at workstations with the noisiest equipment was shown.

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42. Objective tests and assessment of acoustic properties of ear-plugs

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Ear-plugs type hearing protectors are commonly used in noisy working environment. In the certification process of ear-plugs, only the sound attenuation is tested with the subjective method. There is no requirement for maximum variability in ear-plugs insertion loss measured objectively like the requirement for maximum variability in ear-muffs insertion loss. The aim of this paper is to present the methodology and results of insertion loss measurements for ear-plugs. The measurements were carried out in the laboratory test-site meeting EN 24869-3 requirements, for the test signals consisting of pink noise filtered through one-third octave bands with centre frequencies 63–8000 Hz, with newly designed acoustic test fixture. Twenty popular models of ear-plugs made from foam and cotton wool, twenty samples for each model, were tested according to the developed procedure. The mean values of insertion loss and standard deviations for each frequency band of tested ear-plugs are presented.

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43. Method of determination of road traffic noise at workplaces in the office buildings

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Research has shown that traffic noise reaches the workplaces inside office buildings. In many cases road traffic noise is shown by the workers as one of basic factors of noxious work at office workplaces, so it is necessary to estimate it. At office workplaces there is no possibility to estimate it by the measurement methods, because in most cases it is masked in a considerable degree by other noise sources. It is only why it is necessary to estimate the road traffic noise by computational-measuring methods. In this article the method of road traffic noise estimation at workplaces in the office buildings is described. This method is based on noise monitoring in the references points in surrounding, close to office buildings and result of measure special parameters which describe how sound is attenuate during going through the building walls.

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44. Regularisation problems in acoustical inverse method

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This paper presents exploratory problems of regularisation of the inverse method for the investigation of the characteristics of acoustic sources at industrial circumstances. The solution of problem is to find an

effective method for the determination of optimal regularisation parameters in acoustical inverse problem. The sound power of the sound source distribution can be simply deduced from the measured pressure field and the inversion of corresponding matrix of frequency response functions. The accuracy of reconstruction of the sound power of source is crucially dependent on the conditioning of the matrix to be inverted. The success of regularisation depends on the appropriate choice of the regularisation parameter.

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45. Noise exposure of orchestra members measurement uncertainty related to sampling

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One of the objectives in workplace noise measurement and assessment practice is to minimize the costs of testing while ensuring that its purpose is achieved, i.e. it is determined if the permissible noise exposure level has been exceeded. Time reduction results in increased measurement uncertainty whereby the risk that it will be necessary to repeat the tests as recommended by PN-ISO 9612 increases. Noise exposure measurements were carried out in opera and philharmonic orchestras. The technique of equivalent noise level measurement in consecutive one-minute intervals, with full recording of results, was employed. Measurements were performed simultaneously on 4 to 8 workstations. The tests were conducted during rehearsals and concerts of both classical and contemporary music. The results of the measurements carried out in the particular workplaces were subjected to a statistical analysis in order to determine the measurement uncertainty associated with performing the measurements in time intervals of different duration, shorter than the reference time interval. The dependence between the risk of repeating the tests and measurement time was estimated.

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46. Vibroacoustic indexes pressures of sustainable development in the Małopolskie Province

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Environmental vibroacoustic integrates the problems connected from vibroacoustic, protection of environment before noise and vibration and sustainable development. Conception sustainable development is based on create collection indexes and in this days has repeatedly important meaning in different fields of science, technique and lives.

This report introduced tests and calculations indexes pressure of noise in Małopolskie Province. Also sketches Małopolskie Province noise profile and gives a series of considered data.

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47. Polish and foreign criteria of ultrasonic noise assessing at workplaces.
Ultrasonic noise assessing at operational workstations of typical ultrasonic sources

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Ultrasonic noise at workplaces in Poland is defined as the broadband noise containing high audible and low ultrasonic frequencies. The assessment of ultrasonic noise exposure is based on equivalent sound pressure level in the 1/3 octave band, in most states in the world. The main sources of ultrasonic noise in the working environment are the so-called low frequency ultrasonic technological devices, including

washers, welders, ultrasonic drills, soldering tools and galvanizing pots. This article presents a method of assessing ultrasonic noise at workplaces used in Poland and the results of assessing occupational exposure to ultrasonic noise at typical sources.

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48. The method of inversion and the maximum likelihood estimation in acoustic research of industrial sources in the environment

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Determining an acoustic model of a plant is a topic connected with the noise sources' identification in the plant, their localization and acoustic parameters. In order to determine the sources' parameters correctly, it is necessary to use the whole available knowledge assessed in acoustic measurements and the knowledge given a priori (eg. on bases of producers' catalogues concerning the equipment). To solve this problem, the method of acoustic inversion was used with the maximum likelihood estimation. The biggest advantage of this method is the possibility to use the information concerning accuracy of the determined a priori acoustic power of noise sources and indicating the importance of the sound level values in measurement areas. In the article were presented the theoretical assumptions of the method, its adjustment to the industrial conditions and some computer simulations.

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49. Uncertainty of LDEN calculation for corona noise from UHV power lines using the reference methods

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The paper presents an example of combined uncertainty evaluation for estimation of the long-term level (LA,LT) and LDEN level for corona noise from UHV overhead power lines. Some specific features of that noise – large time variation of its level and spectral structure, dependent on the atmospheric conditions and on the other hand, often small distance from the acoustic background level – are the reasons that the evaluation of its estimation uncertainty is more difficult than for some other, better "determined" noise sources. The partial uncertainties related to the measurement system and prediction method according to the reference methods for industry noise were dealt with. The effect of environment on the system and the measured quantity have been distinguished and quantitatively determined.

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50. Study of traffic noise statistics distribution according to long-term levels calculations

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The study of traffic noise at roads and highways are performed in accordance with reference methodologies adopted as implementation to the Law on Environment Protection. The choice of applicable methodology should be based on measurement quality analysis for each particular case. While estimating the measurement uncertainty it is assumed that results are subject to normal distribution. Such solution raises some doubts or even reservations. Therefore, in the present paper the real statistical distribution of road

level noise is examined while examination of its influence on the value of uncertainty of the executed measurements is undertaken.

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51. The discrete inverse theory of determining the acoustic power of different noise sources in a factory

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Reconstructing the described processes or some of their parameters on the basis of experimental data often leads to presented ill-posed problems. Crucial in solving such problems is the *a priori* knowledge. Mathematical models presented in this paper along with the detailed analysis concern classical and bayesan accounts of estimation. Main emphasis was laid on accounting for the stability of the results, which is commonly neglected in the literature. Tendencies in solving conditionally well-posed problems point to their close connection with the methods optimalising calculation processes with considerable aid of specialistic programming.

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52. Efficiency of attenuation high-level acoustic impulses by double protection (earplugs and earmuffs used simultaneously)

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This study was carried out to measure the efficiency of double protection from high-level impulse noise obtained by means of a combination of an earplug and an earmuff. The measurements were conducted using acoustic impulses with 170-dB peak SPL, 14-μs rise time, and 0.4 ms A duration. The tests were conducted for light and heavy earmuffs, combined with foam and winged earplugs. A transmission-loss method was used to assess the decrease in peak SPL and the increase in A, C or D durations of the impulse waveforms recorded under the hearing protectors. To comply with the conditions in which an earplug can be installed under the earmuff, a modified artificial test fixture (ATF, ISO 4869-3) was used. Results were analysed in relation to the impulse noise damage risk criteria developed by CHABA, Pfander, and Smoorenburg. The study has demonstrated that in comparison with a single earplug or earmuff, double protection provides more attenuation of peak SPL and causes a larger increase in duration of the impulse recorded under the HPD.

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53. Acoustic map processed on the basis of periodic measurement of noise connected with exploitation of road

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The noise measurements of the network of national roads were carried out, for the first time in Poland, in 2005. The measurements were conducted based on the disposition of Minister of Environment from the January 23rd, 2003 and executed within the general traffic measurements for highways, express roads and other national and provincial roads. The regulation claims the range of steps needs to be executed by the owner of roads, railroad, tram lines, airports etc. and oblige the owner to measure the allowed levels of substances or the energy in the environment. Those measures provide the information on the actual state of acoustic climate in the selected direct roads neighborhood. The obtained results are directly connected with the parameters of traffic, meteorological factors and the existing urban areas.

According to the article 175 exhibit 6 of the Environmental Protection, the owner of the road, based on the periodic measures, is responsible for composing the acoustic map of the areas located near the selected and monitored roads. This paper presents the realization of the acoustic map based on the acoustic data and parameters of traffic, and the digital map in GIS technology. The presented map has been generated for the section of road that crosses the different level of urban areas.

Physical Acoustics

54. Application of Trefftz method in least square formulation to the radiation acoustic problem

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An indirect Trefftz method (TM) is applied to the solution of the boundary problem for Helmholtz equation. The least square formulation of TM is used. The weighting parameter is established; it is the problem of this variant of TM. An axisymmetric acoustic radiation problem of the ring placed on the sphere is taken into account. Numerical calculations are performed for the pulsating and axially vibrating gap of the sphere. The results are compared to the exact ones.

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55. The frequencies of localized acoustic modes in Au/V nanolayers with capping layer

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The paper presents the results of theoretical analysis of localized acoustic modes, which can be generated in Au/V nanolayers with "heavy" capping layer. The transfer-matrix method was used to evaluate the frequencies of localized acoustic modes in these nanostructures. Up to now, the condition of generation of localized modes in nanolayer structure was that the acoustic impedance of capping layer should be lower than the acoustic impedance of top (next) layer. This condition was in agreement with experimental results. This paper demonstrates the possibility of generation of localized acoustic modes in case of higher acoustic impedance of the capping layer. The frequencies of localized modes for different thickness of the capping layer were obtained.

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56. Ultrasonic chemical sensor with organic monomolecular layer

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In this paper a structure of a ultrasonic chemical sensor with organic monomolecular layer as well as introductory measurement with the help of a set-up constructed in IFTR PAS are presented. Chemical composition of this layer is an equimolar mixture of 5-[[1,3-dioxo-3- [4- (1-oxooctadecyl) phenyl] propyl] amino] - 1,3 - benzenedicarboxylic acid (DA) and cetylamine (CA). The thickness of this layer is equal to

the dimension of one molecule. The sensor layer was deposited on one channel of the bi-channel sensor delay line (made from lithium niobiate) by means of the Langmuir-Blodgett method. The chemical sensitivity of this sensor to some mixtures of air with vapor of volatile organic compounds has been investigated.

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57. Identification of the electro-acoustic object using parametric models

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The electro-acoustic object consisting of a signal source, amplifier and loudspeaker has been considered in this paper. Due to difficulties with the description of this system using mathematical models, which are usually complicated and unfeasible, stochastic models have been introduced. The basis of this method is the observation of the output of the examined system depending on a specific input. In this paper, application of parametric models for identification of dynamic objects has been presented. SISO (single input, single output) model of the electro-acoustic object has been assumed. The velocity of the loudspeaker cone has been considered as the output of the examined system. Optimal model has been found and the model validation procedure was carried out with the Matlab System Identification Toolbox abilities.

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58. Vibration energy flow in assembled structures

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The work presents formulations on structural intensity calculations. The method for structural intensity computation is illustrated and formulas of structural intensity for plates and their relationship with internal force and strain are given. The modelling and computation is done for one- and two-dimensional structures: plates and shells considered here as constructional elements. The numerical method of intensity evaluation was based on complex modal analysis and superposition of modes with use of the finite elements method. There are presented results of the calculations which lead to the assessment of distribution of structural intensity (vector field) on the surface of simply supported rectangular steel plates connected by different types of joints. The models included the source of vibrations (linear force excitation) and sink of energy in the form of linear configuration of damping elements. The changes of finite elements grid density enabled detailed analysis of total vibration energy flow in analysed plates through the place of joint. The solved problem was intended to show the usability of structure surface intensity method in diagnostics of joints and role of stiffeners in mechanical constructions, especially those typical for the vehicles as means of personal transport.

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59. Applications of dispersed phase acoustics

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This paper summarises the basic theory of dispersed phase acoustics and gives an overview of the state of the art in the areas of application, with particular emphasis on recent developments. The problem of the influence of the acoustical field on dispersed phase in the fluid has been studied in connection with application of acoustic coagulation for precipitation of gases. In the process of the acoustic coagulation the mean particle size increases, reducing the toxicity of the aerosol and facilitating its further cleaning by traditional method. This subject is one of fundamental physical effects of sound and contains important aspects of the natural environment protection.

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60. FEM modelling of sound radiation from a beam with piezoceramic elements

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This paper presents a study of sound radiation from a cantilever beam with attached ceramic elements made of material displaying the piezoelectric properties. Two sets of collocated piezoelectric transducers were bonded to the beam and they were used for actuating and sensing. One of actuators served to drive the beam by applying harmonic voltage on electrodes. The voltage frequency range varied from 10 Hz to 3.2 kHz. Vibration damping was performed by using the second actuator. The frequency of damping voltage was the same as the excitation frequency, its phase shift was 0 or $180°$ and the amplitude was tuned to obtain the best results. The beam was placed in an acoustic volume, where sound radiation occurs. Sound field distribution was obtained in selected resonance frequencies in a steady state. Results were derived by means the Finite Element Method.

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61. Parametres characterising vibrations of oscilators with damping forced by stochastic impulses

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The work was inspired by attempts to construct a measuring device that would control the composition of the medium in a dust pipeline. The difficulties that arose then in connection with statistical interpretation forced us to search for a mathematical model that would explain its causes. In the study we will consider an oscillator that is subject to impulses whose magnitude and moment of action are random.

First, we will present a universal mathematical reasoning and a theorem that will allow us to calculate the basic parameters of stochastic variables such as mathematical expectation or variance. We will apply these results for the oscillator with damping. We will calculate mean value of the amplitude of this oscillator as well as its theoretical variance related to time and characteristic parameters of the oscillator. Further, we will carry out our numerical simulation, compare the results of the simulation with theoretical calculations and explain the differences that may occur.

The obtained results will allow us to suggest possible methods of explanation of the statistical qualities influencing the system depending on statistical characteristics of measurements.

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**62. Anisotropy of acoustic emission and Portevin-Le Châtelier phenomena
in polycrystalline aluminium alloys subjected to tensile tests**

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In the present work the acoustic emission (AE) method has been used in the plastic instability investigations related to the Portevin-Le Châtelier phenomenon (PL effect, nonhomogeneous strain, jerky flow)

occurring in polycrystalline aluminium alloys subjected to tensile tests at ambient temperature. There have been observed very essential correlations between the EA and PL phenomena and a strong anisotropy of both these effects in samples cut at various angles with respect to the initial rolling direction has been found. The results of AE measurements were obtained using a new AE analyser and, for a few samples, they have been compared with those obtained by applying an analyser of older generation, used till now. Moreover, the new software allowed additionally to carry out the analysis of single AE events, which, in turn, created better possibility to determine the relations between the nonhomogeneous strain mechanisms of the PL type and the mechanisms of AE events generation. The results are discussed also in the context of the existing models of the PL effect and the theoretical concepts of AE sources.

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63. Investigation of influence of defectiveness in aluminous porcelain structure on fracture process under compressive loading using acoustic emission method

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The paper presents the results of acoustic emission (AE) and microscopic study of ceramic samples subjected to compressive stress. The specimens for research were made of insulator aluminous porcelain 130 type. Purpose of this work was registration of the stages of the process of degradation in ceramic material structure. Microscopic study enabled us to observe structural parameters of the material before loading as well as at particular stages of the process of defects development. Influence of technological faults existing in the material structure on mechanical-acoustic characteristics and mechanical strength of the samples was determined.

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64. Spectral analysis of acoustic emission signals generated in Ag crystals by twinning and shear-band formation processes during channel-die compression

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In the paper are presented the results of investigations of the relations between acoustic emission (AE) and the mechanisms of twinning, as well as shear band formation and propagation in silver single crystals of {112}<111> orientation, subjected to channel-die compression tests at ambient temperature. The results were obtained using an AE analyser of a new generation, installed recently at the Institute of Metallurgy and Materials Sciences, and were compared with those obtained also for single Ag crystals of the same orientation, tested at the room and at liquid nitrogen (-196°C) temperatures, but detected by applying an AE analyser of older generation, used until now. The results of AE measurements obtained using the new analyser allowed to carry out the preliminary wavelet analysis of AE signals, which – in turn – offered better possibility to solve the problem of identification of the strain mechanisms using the AE method. The results are discussed also on the basis of the existing models of twinning and theoretical concepts of AE sources.

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65. Construction and application of Green's function of the problem
of sound radiation by a circular sound source located near the two-wall corner

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Construction of Green's function of Neumann's boundary problem of Helmholtz equation at the two-wall corner has been considered. Green's function has been expressed in its Fourier representation and has been used for computations of the sound radiation pressure and sound radiation power of a flat circular source located in one of two rigid baffles of the two-wall corner.

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66. Application of Green's function for acoustic radiation
of a source located near the two-wall corner

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This paper focuses on the problem of sound radiation of a harmonically vibrating rectangular piston embedded into one of two baffles configured spatially as the two-wall corner. The sound radiation pressure and sound radiation power, active and reactive, have been presented as their Fourier representations using Green's function. The directivity pattern has been expressed in terms of some elementary functions, whereas the radiation efficiency has been expressed as a low frequency approximation. The elementary formulas obtained make it possible to clearly interpret the influence of the baffles of two-wall corner on the sound radiation of the piston.

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67. Low frequency approximation of mutual modal radiation efficiency
of a vibrating rectangular plate

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This paper presents some elementary formulations for the mutual modal radiation efficiency of a simply supported rectangular plate embedded in a rigid infinite baffle. The magnitude makes it possible to introduce the intermodal plate's interactions into the total radiation efficiency of the plate vibrating under the influence of an external surface force. The approximate formula has been expressed as a combination of some trigonometric and special functions. The formula is convenient for some numerical computations of the modal and total radiation efficiency values of the plate.

Electroacoustics

68. The application of the resilient backpropagation algorithm and power spectrum density for recognizing the acoustic emission signals generated by basic partial discharge forms using artificial neuron networks

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The subject matter of this paper consists in correct recognition of the acoustic emission (AE) signals generated by basic partial discharge forms (PDs). The paper presents the research results of application of unidirectional artificial neuron networks (ANN) for recognizing basic PD forms that can occur in paper-oil insulation impaired by the aging processes. The research work results present the recognition effectiveness of basic PD forms depending on the number of basic forms passed simultaneously onto the network inputs and the size of the teaching sequence. Power spectrum density was assumed as the parameter of the AE signal generated by the assumed PD forms. The paper presents also the results of the network effectiveness analysis depending on the number of the points averaging the power spectrum density, the number of neurons of the concealed layer and the size of the teaching sequence.

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69. Time – frequency analysis of the AE signals generated by PDs on bushing and stand-off insulators

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The subject matter of this paper concerns the application of the acoustic emission (AE) method for the measurement and analysis of the acoustic emission (AE) pulses generated by partial surface discharges (PSD) occurring on the bushing and stand-off insulators. Within the research work performed, the results of which are presented in the paper, the AE pulses generated by PDs were measured at the changes of metrological and technical parameters for the high-voltage experiments carried out. The research scope included the comparison of the results of the time – frequency analysis of the AE pulses generated by PDs in the bushing insulator at the distance changes between the insulation grip and the ferrule, and at the internal electrode diameter changes. Summing-up, the comparative analysis was carried out for the results obtained in the time – frequency domain for the bushing and stand-off insulators.

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**70. Wide-frequency, high-voltage amplifier for determination
of the frequency response characteristics of mesurement microphones**

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The electrostatic actuator method uses an electrostatically produced pressure to excite the microphone diaphragm. Systems for measurement of electrostatic actuator response of a microphone consist of two

parts: a system for electrostatic excitation of the microphone diaphragm and a system for determination of microphone output voltage. The AC voltage (typically 30V) and DC voltage (typically 800V) applied to the actuator will be chosen such that noise and harmonic distortion (the second harmonic) will not influence the measured response significantly. The paper presents an example of set-up using Audio Precision Analyzer and self-construction actuator supply for accurate measuring the pressure frequency response of condenser microphone in the range of 10 Hz–200 kHz.

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71. Control of directivity pattern of sound source

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In this article we present a sound source with controlled directivity pattern. The sound source consists of 24 dynamic loudspeakres. It is possible to change direction of the main lobe of directivity pattern by setting delays for each of loudspeakers. We also present an algorithm for setting gains and delays for each loudspeaker.

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72. Nonuniform sampling of acoustic signal for active noise control

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The classical approach to the signal sampling process assumes necessity of high order analogue filters to avoid aliasing effect. Anti-aliasing filters can introduce complicated dynamics into the signal processing path what is undesirable from the point of view of the control algorithm implementation. Different possible techniques to replace analogue filters in the system design are considered. One of the approaches introduces into the signal sampling process deliberate irregularities, which can be helpful in suppressing aliasing. Then the analogue anti-aliasing filters can be replaced by digital signal processing methods. The proposed innovative approach is efficient for the control purposes, what was shown on the example of ANC system. The presented idea was illustrated by results of real-world experiments concerning creation of local spatial zones of quiet enclosures.

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73. Diffraction correction of frequency response for loudspeaker in rectangular baffle

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The problem of diffraction correction of frequency response of loudspeaker in finite baffle was considered by H. Olson in thirties of the XX century. He found experimentally the frequency responses of corrections caused by interference of direct and diffracted waves. He predicted the necessity of eccentric placing of loudspeaker in the baffle in order to avoid a deep dip in frequency response for frequency higher than twice as for a lower limiting frequency of the baffle. However, the problem was never solved theoretically except for the simplified case of loudspeaker centrally placed in circular baffle. In the paper, a theory of diffraction on the baffle edge of the wave radiated by a point source eccentrically placed in the

rectangular baffle is presented. The results of calculations of the diffraction corrections for various configurations of the source and the baffle are presented as well. The statistical dependence between irregularity of the frequency response of the diffraction correction above the lower limiting frequency of the baffle and standard deviation of the diffraction path is shown. The conclusions can be useful for design of the process of the baffles.

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74. On electro-acoustic plants identification using higher-order spectra analysis

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The paper deals with the problem of on-line identification of electro-acoustic plant models for an active noise control (ANC) system. Adaptive ANC algorithms are parameterized with the models of secondary and feedback paths. If these paths are time-varying, the models have to be updated during ANC system operation. Several problems like inherent feedback loops, low signal-to-noise ratio, and correlation of the identified path input and disturbance signal make the on-line identification very difficult. In this case classical identification algorithms often give biased and inconsistent estimates. The author suggests to improve the quality of obtained estimates by using identification methods employing higher-order spectra (HOS) and signal averaging. HOS – based methods allow to reduce the influence of additive Gaussian disturbance on identification results. Signal averaging allows to improve the signal-to-noise ratio without deteriorating noise attenuation, and the caused disturbance tends asymptotically to a Gaussian process. The paper presents several laboratory experiments results, showing effectiveness of the proposed solution.

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75. "Real surround sound" algorithm for remastering of 2-channel archival recordings

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The method of the extraction of spatial information from 2-channel audio signal is presented in the paper. The proposed algorithm will be used to recover true spatial acoustical field for 5.1 surround system from archival 2-channel stereo-recordings. There is a lot of such recordings (digital as well) which can be more attractive, when postprocessed to 5.1-channel standard and reproduced in home theater systems. The idea of the proposed approach is based on special utilization of amplitude-phase dependences in input audio signal. The authors have created a nonlinear filter of spatial information which intelligently splits 2-channel sound to 6 output channels in DTS 5.1 format. The proposed algorithm is also compatible with analog Dolby Surround coding. The efficiency of the method is proven objectively and subjectively.

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76. New trends in sound reinforcement systems

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This paper presents the actual state of art of sound reinforcement system's designing. Basic structure of modern digital electro-acoustical system is explained at the example of one has been installed at Wrocław

Opera House. Some aspects of sound propagation at this type of venues are presented. This article is focusing on proper audience area sound coverage, achieving smooth frequency response, getting directive propagation at low frequencies, ways of protection against electro-acoustic feedback. The way of solving all of these aspects have been tested during the installation and the tuning of the system at Wrocław Opera House. Achieved results prove that it is possible to acquire these targets. The philosophy of audio signal serving for active loudspeaker cabinets is presented.

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77. Digital signals transmission at modern sound reinforcement systems

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This paper presents new aspects of modern sound reinforcement system's designing which came into view because of prevalence of digital technology. Using digital equipment as well as digital signals transmission between them, caused fundamental reviewing of signal path philosophy at electro-acoustical systems. This article is focusing on some aspects connected closely with digital transmission of audio signals. One of them is proper clock synchronizations of all digital devices present in the system. Another one is compensating time delays at different digital signal ways. Important part of modern digital systems is the control layer. This allows to control each independent device as well as every subsystem, e.g. behavior of wireless microphones or loudspeaker cabinets. Some topics related to these functions are presented in this article. Some measurement and tests concerning the topics presented in the paper have been done during installation and tuning of the system at Wrocław Opera House.

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78. Filter calibration according to the requirements of PN-EN 61260 standard

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The article shows requirements of the Polish national standard PN-EN: 61260 regarding filters with band-width of 1/1 octave and 1/3 octave and the calibration method with respect to above requirements. The filter sets as stand-alone modules are becoming less popular in electroacoustics so that the paper focuses on filter sets as built-in modules of sound level meters. It also contains some view on type approval and periodical calibration and the uncertainty assessment.

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79. Influence of electro-acoustic plant on performance of active noise control systems

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In the paper different aspects of influence of electro-acoustic plant on performance of active noise control (ANC) systems are discussed. The adaptive ANC systems creating three-dimensional zones of quiet in enclosures are considered. The electro-acoustic plant in such systems is characterised by specific,

complicated dynamic properties. The influence of plant dynamic properties on convergence of adaptive control algorithm is described. In particular the problems of the algorithm convergence speed and the possibilities of ANC system chaotic behaviour are discussed. It is shown how structure and performance of multi-channel ANC systems depend on electro-acoustic plant dynamics. All the cases discussed are illustrated by the results of simulation and real-world experiments.

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80. New approach to headphones equalization for HRTF processed sound

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Head Related Transfer Function (HRTF) technology is widely used to externalize audio scene when the stereo audio signal is listened using headphones. However, the best results of the externalization are obtained, when individual HRTFs are used. So it will be comfortable to may do the HRTF measurement at home. In such a situation processed sound is frequently colored due to irregularities in transfer characteristics of non-perfect (and cheap) measurement equipment. The effect of coloration can be diminished using inverse filters based on the same HRTF used before to externalization but properly averaged using psychoacoustical model of the human hearing system. This approach is described and deeply tested by the author. Objective and subjective results are presented in the paper.

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81. Reduction of harmonic distortion in power amplifiers at extremes of audio band

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Harmonic distortion created in audio power amplifier, which is operated in midband up to the limitation threshold, rise at exteremes of the amplifier bandwidth. In low frequency range, this is caused by limited capacitance of ripple filtering capacitors in non-stabilized mains power supply unit, while in high frequency range – by limited value of slew rate coefficient. In order to reduce harmonic distortion at audio band extremes, this paper suggests to place a band-pass filter, instead to now and then used low-pass filter, between voltage amplifier output and power amplifier input. The structure of such filter and the relationships which specify its corner frequencies are provided. Computer simulation results have proved that due to amplifier bandwidth limitation (small-signal bandwidth), the harmonic distortion at audio band extremes can be maintained at similar level to that for midband while power bandwidth (large-signal bandwidth) can be still wider than the audio band.

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82. Influence of acoustical properties of a listening room on the consistency between sound fields reproduced using standard stereo technique and headphone technique with HRTF processing

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Results of the analysis of acoustical properties of three different listening rooms and its influence on the subjective and objective fidelity and consistency between sound fields reproduced using two loudspeakers in standard stereo configuration and headphone feed with the signal processed using a method of sound

externalization developed by the authors based on the modified HRTF technology are presented in the paper. The experiments allow deep insight into the sound source localization by a human in closed space and improvement of the processing algorithm for the sound presentation using headphones.

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83. Influence of power supply capacitors on maximum output power of audio power amplifier

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The paper investigates how maximum output power of audio power amplifier is affected by (i) capacitance of capacitors which filter ripples in non-stabilized mains power supply unit and (ii) frequency of sinusoidal control signal. The outcomes are referenced to lower 3-dB frequency of amplifier power bandwidth. It is shown that the drop of the maximum output power at the low-frequency end of the audio band, caused by limited capacitance of power supply filter capacitors, is a better criterion to determine their capacitance than the ripple coefficient of power supply unit. The findings are that the capacitance of mains power supply unit capacitors is of negligible effect on the signal-to-noise ratio at amplifier output and is of no effect on its small-signal bandwidth.

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84. Directional radiation of a group of point sources

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The acoustic antenna made of a set of sources of omni or given directional pattern is analyzed. It is shown that placement of sources in straight line and adjusting the time delays according to wave retardation creates the line running wave array (LRW) of the narrowest beam (the phenomenon known in radio engineering and resembling the principle of radiation of nonlinear acoustic parametric arrays). Detailed examination of LRW antenna, expressions for parameters calculation and graphs enable antenna designing for assumed 3 dB beam width. Two proposals of LRW antenna realization are given with the use of electronic delay line and in form of a pipe with holes in the sidewall and with muffled end. In connection with antenna design process the inverse radiation problem (IRP) for a discrete N-source array has been formulated and existence and stability of solutions was examined. It is shown under what conditions IRP algorithm leads to results of practical sense. The idea of decomposition of a given directivity pattern into the set of permissible elementary patterns has been outlined.

Psychoacoustics

85. Computational errors of acoustical parameters calculated from vibration measurements using scanning laser vibrometer

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Many acoustical problems are solved by the boundary elements method (BEM). The most critical input data in BEM are proper boundary conditions. The accuracy of calculations of a well-posed BEM model depends mostly on accuracy of the boundary conditions. Commonly one deals with so-called Neumann problem, where normal velocity distribution on the object under investigation is known. Moreover,

the velocity distribution can be precisely measured using scanning laser Doppler vibrometer (SLDV). Unfortunately, SLDV measures vibration (velocity) along the laser beam, whereas in BEM model one needs a normal to object's surface velocity. Therefore the measured data has to be scaled before putting it to BEM model. As a rule, the process of scaling is time-consuming. In the paper, the influence of scaling on computational errors of acoustical parameters, calculated from vibration measurements using scanning laser vibrometer, is presented. It was shown that in some cases errors of scaling of the measured velocity are negligible and the scaling is not necessary.

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86. Perception of amplitude modulation by normal-hearing and hearing-impaired subjects

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The perception of amplitude modulation (AM) plays an important role in many aspects of auditory perception (for example speech perception) and in the ability to analyze sound arising from different sources. Hearing-impaired people often find it difficult to understand speech in the presence of background noise and it is possible that part of this difficulty comes from abnormalities in the presence of amplitude modulation. The experiment reported has been undertaken to examine the ability to process complex patterns of AM applied to a single sinusoidal carrier. Five subjects aged 20–30 with audiologically normal hearing and five subjects with sensorineural hearing loss participated in the experiment. Three Alternative Forced Choice (3AFC) paradigms were used and 1-up, 3-down adaptive procedure. The level of the stimuli was set at 50 dB SPL for the normally hearing subjects. For the hearing impaired subjects the level was adjusted individually to produce comfortable loudness. These results are consistent with experimental data, which suggest the existence of frequency selectivity and tuning in the amplitude modulation domain. The data obtained for the hearing impaired subjects and the normally-hearing ones show some significant similarities.

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87. Examinations of the noise threats and their impact on hearing in selected schools

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The noise measurements conducted in selected schools located in Gdańsk area were presented in this paper. The main aim of this research was a determination of the noise threats at schools. The objective measurements of the acoustic climate were performed employing the noise monitoring station engineered at the Multimedia System Department, Gdańsk University of Technology. Simultaneously, subjective noise annoyance examinations were carried out among pupils in chosen schools. A noise analysis in place of residence and music preferences were included in the survey. The preliminary hearing test results after an exposure to noise being present during breaks was also included. Employing a distortion product otoacoustic emission (DPOAE) method, hearing tests have been performed twice, before and after the noise exposure. The noise dose analysis taking into consideration an average time spent by a pupil in a school was also presented. The results obtained of the noise measurements revealed that an unfavorable noise climate occurred in the schools surveyed. This was also confirmed by the subjective examination results. The conducted hearing tests did not reveal essential changes in cochlea activity of pupils examined. This means that the noise during breaks and physical exercises did not constitute a risk for hearing system of the pupils. However it may be considered as an essential source of annoyance.

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88. Modulation masking for recurrent low-noise-noise masker

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The main purpose of these investigations was to examine modulation masking phenomenon for recurrent low-noise-noise masker. This kind of an interfering signal was generated by self-copying of an initial LNN realisation in the time domain. Such masker is characterized by three parameters, namely: repetition frequency, f_{rep}, centre frequency, f_o, and bandwidth, b. The parameter f_{rep} is not reflected in the signal power spectrum and is related to autocorrelation period. The parameters f_o and b describe spectral properties of the interfering signal, i.e. localisation and concentration of its power in the frequency domain.

In order to separate possible effects of the masker temporal repetition and its spectral parameters, modulation masking measurements were carried out for $f_o = 64$ [Hz], b = 16 [Hz] and $f_{rep}=1$ (without repetition), 4 and 8 [1/s] and probe signal of frequencies, $f_p = 1, 2, 4, 6, 8, 12, 16, 32, 52$ and 64 [Hz]. The masker rms modulation depth was 30%, the carrier signal was a 4-kHz sinusoid. The modulation masking is determined by the spectral properties of the masker: its magnitude decreases as the difference between f_o and f_p; the phenomenon is not influenced by masker period, i.e. local maxima of masking patters are not observed for probe signal rates equal to $f_{rep.}$

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89. The threshold of the residual pitch in three-component inharmonic stimuli

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The paper presents new results of the first residual pitch shift effect research in three-component complexes. The appearance of this effect is the most important evidence, that the difference tone introduced by the nonlinearity of hearing system does not influence residual pitch perception also in three-component complexes. The subjects in the adjustment procedure matched the three-component complexes pitch to the same sensation produced by pure tone. The subjects listened to three components, the harmonics of 200 Hz, which were equally shifted in frequency domain. The 30 Hz shift was applied. The frequency range was 630-4030. The hearing experiments show the existence of the threshold of the first residual pitch shift effect. These results are confirmed by the pitch perception models: M.Slaney and R.F Lyon based on the Licklider duplex theory and the Terhardt pitch algorithm.

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90. The Polish sentence test for speech intelligibility measurements

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The main purpose of this study was to prepare Polish sentence tests for measuring speech intelligibility against an interfering noise. The tests were developed from meaningful sentences taken from everyday utterances, TV, literature etc. Two sets of sentence lists were created. The first set was optimized for the so-called binary scoring and was composed of 25 lists of 20 sentences each, while the second set was prepared for word-based scoring and was composed of 22 lists of 20 sentences each. The respective lists were statistically and phonemically balanced, i.e. produced comparable psychometric functions and revealed

comparable phonemic distribution. The mean SRT (Speech Reception Thresholds) and S_{50} (slope of a psychometric function at SRT point) were: -6.06 dB and 29.54 %/dB for the binary scoring and -7.44 dB and 26.65 %/dB for the word-based scoring, respectively. The test lists comply with the requirements of the high quality test for measuring speech intelligibility of the Polish language.

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91. Practical aspects of using HRTF measuring device

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Measurement of Head Related Transfer Function is complicated due to the object of the test, namely transfer function of acoustical arrangement composed of pinna, head and torso. Test involving the participation of a person requires providing appropriate conditions for conducting the measurement. Particularly important is maintaining constant geometrical configuration of sound source and the microphone placed in the ear's channel. Fulfilling this condition as well as determining exact position of sound source in relation to the measurement microphone, may require application of a special measurement device. The paper presents the results of measuring HRTF function using HRTF measuring device and comment on them. The problems encountered during the measuring process are discussed and the possible solutions are suggested. Finally, the results of tests for a human subject and for an artificial head are displayed in the paper.

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92. Automatic test-bench to HRTF measurements

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Head Related Transfer Functions are characterising transmittance bound with the shape of person head and ear concha. Big differences of these functions are occurring to the reason from this. For applications of which, it is necessary to accurate simulating sources of the sound position in space an individual HRTF measurement is necessary. Accurate determining of characteristics requires to move the source of the sound in space. At even not a big resolution of 15 degrees it means a need to perform measurements in several hundred points. The measurement is becoming very time-consuming and arduous for the examined person. An automatic system to HRTF measurements was presented in the paper. This system is letting the HRTF measurement with big three-dimensional resolution in the relatively short time. The system is utilizing many sound sources switched over and the revolving test-bench for the realization of this goal.

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93. Factory workers' cochleas physiological condition

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The influence of specific factory noise on cochleas condition has been analyzed. The main aim of the study was to determine the nonlinear distortion products (DP) of the cochlea and to determine pure tone

audiograms in full frequency range (125, 20 000 Hz). The measurements were performed for the group of 27 factory workers and the control group of 10 people with normal hearing (NH). Each subject was characterized by the hearing threshold, UCL, dp-gram and input-output function of otoacoustic emission. The dp-grams were measured for the three levels of two-tone (85/75, 75/65 and 65/55 dB SPL) and frequencies between 0.5 and 12 kHz. The I/O function was measured for 45–90 dB SPL and frequencies 2, 4, 6, and 8 kHz. The correlation between the seniority (understood as the time one has performed a given job), kind of the job and physiological conditions of cochleas was analyzed.

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94. Pilot survey of the hearing ability among Polish students

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The paper contains the results of monitoring Polish students' hearing ability. The age of survey participants was between 19 and 24 years. This age group was selected due to the fact that participants did not have any exposure to noise in their work environment, and thus they had no decline of hearing ability. The survey was made by applying threshold tonal audiometrics, which may be regarded as a pilot survey. Furthermore, the application of interview methodology enabled the analysis of various aspects, such as the environment of participants and selected factors affecting their hearing ability. Also, the comparison of the audiometric survey with the perception of the noise issue among participants is interesting.

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95. The hearing ability of the students being educated to apply their hearing skills professionally

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The presented research concerns the hearing ability of the specific group of students who will be using their hearing skills professionally. This includes sound engineers, sound technicians and musicians. As the research conducted by national and foreign institutes reveals, ca. 70% of musicians suffer certain hearing damage. This research was performed among students majoring in vibroacoustics and sound engineering. The methodology included both the threshold and suprathreshold research conducted by means of tone audiometry and concerned with the aural fatigue.

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96. Phase problem in virtual pitch perception

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One of the properties of virtual pitch which is most difficult to explain is the virtual pitch weak dependence on the phase of the components, which elicit this pitch. It is a special challenge for the most popular time-domain models of virtual pitch. In this paper, a coherent model of perception of both virtual and tonal pitch is proposed, which also solves the problem of phase. This model is based on spectral-time analysis of the sound signal.

Molecular and Opto Acoustics

97. The Fourier analysis of picosecond acoustic signals generated by laser beam in Au/V nanolayers

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The paper presents the results of study of picosecond acoustic signals generated by femtosecond laser pump pulse in Au/V layer. Au/V nanostructures with a period of 102-205Å located on MgO substrate were studied. Dependence of the measured changes of the laser light reflectivity from nanostructure surface on different delays of probe beam was examined. Peak frequencies obtained by FFT analysis were interpreted as frequencies of acoustical localized modes. The obtained values of these frequency peaks are in agreement with numerical results. In the same sample, localized modes were excited simultaneously in both forbidden gaps.

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98. Holographic imaging of cylindrical ultrasonic waves

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The theoretical and experimental studies of light interaction with ultrasound having cylindrical symmetry have recently attracted considerable attention due to their possible applications in laser technology. In this paper we report the application of optical holographic interferometry for visualization of ultrasonic field generated by a vibrating cylindrical transducer. The theoretical background of the processes of hologram recording and reconstruction in the case of cylindrical wave was presented. Additionally, we performed the experimental verification of theoretical considerations by means of optical holography.

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99. Representation of the laser self-mixing effect in an acoustic signal

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The purpose of the work is to check the possibility of observing the optical phenomena in the gas laser plasma using a microphone. An RF-excited slab-waveguide carbon dioxide laser is used in the experiment. The investigations are performed on a three-mirror resonator structure. An outside mirror is fixed to a vibration exciter to obtain wave returnig to the laser resonator. In that way a self-mixing phenomenon is observed with the optical detector. The response of the laser plasma changes is detected as an acoustic signal. The results of the investigations can be applied for controlling the laser tuning with a microphone.

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100. Molecular association and relaxation phenomena in water solutions of organic liquids examined by photoacoustic and ultrasonic methods

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Recent examinations of water solutions of organic liquids using in parallel both the photoacoustic and ultraconic methods have shown certain possibilities of wider interpretation of the phenomena connected

with appearance of short-living clathrate structures (pseudostable quasi-crystalline associates) and relaxation processes taking place in such media as a result of excitation by the light or by ultrasonics. In the review article some examples of application of both measuring methods in liquid solutions will be presented and their possibilities in examination of above-mentioned phenomena will be discussed in these aspects which allowed a common interpretation of the experimental results obtained.

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101. External magnetic field dependence of restructuring differents magnetic fluids

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This work presents experimental results on acoustic and magnetic properties of different magnetic fluids: APG 513A, APG 832, APG 833, APG 834. The measurements of changes in the ultrasonic wave absorption coefficient $\Delta\alpha$ as a function of the external magnetic field in the range of 10–150 kA/m and the temperature of the magnetic fluid in the range of 0–60^0C were carried out. Measurements were conducted at the ultrasonic wave frequency of 3.6 MHz by a pulse method using ultrasonic MATEC set-up. The direction of ultrasonic wave propagation was parallel to the direction of the external magnetic field. The results of this experiments suggested that in magnetic fluids happen different effects connected with restructuring fluids. The next experiment showed the dependence of the ultrasonic wave absorption coefficient on the intensity of the external magnetic field for different sweeping times, at the constant ferrofluid temperature. These measurements showed that the rapid changes of magnetic field caused very small variation $\Delta\alpha$ which means that restructuring of magnetic fluid does not keep up with changes of the magnetic field. For longer sweep times of the external magnetic field the clusters are formed in ferrofluids which was indicated by maxima appearing in the plots. Additional information about magnetic liquids was obtained by magnetic measurements enabling the estimation of average sizes of the magnetic particles.

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102. Experimental investigation of CoFe2O4 particle size
and acoustic properties of magnetic fluid

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In this paper magnetic particle size and acoustic properties of the ferrofluid with CoFe2O4 particles are presented. The results acquired by means of atomic force microscope measurements will let us determine average value for the hydrodinamic diameter of magnetic particles appearing in CoFe2O4 ferrofluids. The knowledge of these sizes is extremely useful because in the further stage of examinations it allows us to determine the size of surface coating particles. It is possible by making additional magnetic measurements enabling to know the size of average magnetic core contained in the ferrofluid. Also, it allows us to determine in a simple way the thickness of the magnetic particle coating. Such information on magnetic particles in a given ferrofluid are very valuable in the context of application of the liquids either in technology or in medicine. Moreover, ultrasonic measurements carried out are providing the valuable information for us on the subject of the ferrofluid stability exposed to the action of the external magnetic field. Experimental estimation of the absorption coefficient ultrasonic wave in the function of field for a few temperatures allows us to forecast how magnetic particles in a given magnetic liquid are capable to join together and create clusters, and how big aggregates can be created in this way.

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103. Acoustic studies of aqueous solutions of polyethylene glycol 400

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The absorption, velocity of ultrasound and the density have been measured in mixtures of water and polyethylene glycol (PEG) 400 in the temperature range from 291.15 to 309.15K. The investigation of ultrasonic attenuation spectra were carried out in the frequency range of 100 kHz – 1 GHz at 298.15K.

The variations of ultrasonic velocities and adiabatic compressibility coefficient with concentration and temperature have been studied. Structural interactions and the formation of a compact pseudo-stable structure in the region of a very low polyethylene glycol 400 concentration have been observed.

The experimental values of ultrasonic velocities for various concentrations have been used to calculate the apparent excess speeds of sound. The excess properties presents the detailed knowledge about the deviation from ideal, and thus it is responsible for assessing the structural variation and the type of molecular interactions. Ultrasonic attenuation research allowed us to determine the relaxation time of the observed molecular process.

Musical Acoustics

104. New method of estimation of individual judgment in psychoacoustic

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According to the recent theoretical research in psychometrics and to our considerations, we present a new approach to the problem of univocal evaluation of acoustical stimulus. To the instrument of evaluation belongs the homogeneity of the particular judgment of jury members. The concept is illustrated by analysis of the data obtained from the magnitude estimation methods and results of the music psychology research.

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105. Instruments matching via timbral features

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In the paper the problem of matching instruments according to the timbral similarity is considered for a set of violin. The fact that the instruments are of the same type makes the subject particularly challenging. The starting point of the research is calculation of a set of specific signal processing derived features based on harmonic analysis, e.g. odd-to-even harmonics amplitudes ratio, intensity of the first and higher harmonics etc., and a set of linguistic descriptors of violin timbre related to these features. The semantically disjoint categories of timbre characteristics are proposed. The result of the analysis is the annotation of the instruments to those semantic categories and creation of a map of similarly sounding instruments. The outcome of the research provides supportive cue for further analysis. It attempts to fill in the existing semantic gap between the human and machine levels of sound understanding and to provide the enriching aspect to the design of methodology of inferring preference models from the objective characteristics of musical sounds.

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106. Drumheads expend and its influence for sound parameter

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The paper reveals sound difference between new and expand drumheads. The diaphrams are in three levels of expend: new, slightly used and hardly used. Analysis of sound and vibration has to show the difference between these three levels. The subjective feeling of a playing musican was major part of the research.

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107. Musical instruments samples' tuning evaluation algorithm

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This paper presents an algorithm, which evaluates tuning of musical instruments' samples. The first chapter introduces algorithm's foundations and goals, distinguishing it from similar, earlier solutions. The second chapter presents the construction and working principles of the algorithm. The third one includes the test results, showing the range of algorithm's applicability. Finally, the basic application of the algorithm and possibilities of its further development are presented.

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108. The mathematical method of describing properties of the sound of musical instrument

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The paper describes the mathematical method of determination of the characteristic properties of the sound of musical instruments. The method is a result of the analysis of the sound of violins, which were used for the 10th Henryk Wieniawski Violin Making Competition in Poznań in 2001.

The main aim of the method was the study of instrument response to the stimulation by sounds of chromatic scale. The additional assumption was that the sound of a tested instrument must be induced in the way proper for a given instrument.

The method includes description of chromatic scale as a stimulating signal and the analysis of response of the instrument. The analysis is performed in the frequency domain and spectrum of the sound of instrument is compared with the spectrum of chromatic scale by means of statistical analysis.

The presented method can be used to study and analyze the sound of each musical instrument that produces sounds in the chromatic scale.

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109. Modeling and analysis of peer-to-peer streaming

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The article is a study of current progress in peer-to-peer streaming.

The idea of peer-to-peer networks is now about seven years old. Its use for multicast or streaming is even younger. Many software packages have been written and deployed. The most astonishing fact about

the subject, however, is the lack of theoretical background knowledge. The article reviews this knowledge. The main contribution however, is the definition of parameters that a model for such a network should have. There we define what properties a streaming signal should have and what operations will be performed on it. The design of simulation environment then follows with comparison of the known network topologies embedded in proposed model.

Transducers

110. PbFe1/2Nb1/2O3 ceramics as a base material
for electromechanical transducers

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PbFe1/2Nb1/2O3 (PFN) material of perovskite structure was rising interest because it connects both ferroelectric and antiferromagnetic properties. The paper presents the tests of PFN ceramics obtained as a result of sintering simple oxides. As a comparison, the base composition of the ceramics and composition with lithium admixture was synthesized. Densification was carried out using two methods: conventional sintering and hot pressing. XRD patterns, SEM micrographs of fractures surfaces, dielectric and electromechanical properties were performed.

Admixing of PFN ceramics with a little amount of lithium allowed to obtain ceramics with a better set of parameters from the point of view of their practical application. The method of densification by hot pressing additionally improves these properties.

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111. Characterization of Pb(Zr,Ti)O3 piezoelectric thin films
by AC impedance spectroscopy

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AC impedance spectroscopy is a powerful tool for the characterization of electrical behaviour of ferroelectric materials. Electrical response is determined by several factors, of which ion and electron mobility is particularly important and critically dependent on the structure. In the present study PZT-type thin films were fabricated by the RF sputtering method. Structural differences such as small atomic/ionic displacements are observed in PZT-type piezoelectrics. They can have a significant influence on usefulness of a material for a particular application. Simultaneous representations of complex impedance, admittance, permittivity, modulus and dielectric loss tangent, versus frequency were used to resolve the contribution of the electrode effects, bulk effects and the interfaces to impedance of PZT-type thin films. The equivalent electric circuit model was applied to characterize the contribution of the polarization processes in the polycrystalline thin films. Great application potential of the PZT-based thin films was considered and possibility to employ the as-obtained PZT thin films as active elements of the piezoelectric transducers was reported.

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112. PLZT ceramics as the material for electroacoustics

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Lanthanum modified lead zirconate titanate (PLZT) materials are formed by adding La^{3+} ions to a PZT composition. The La^{3+} additions counteract the natural p-type conductivity and raise the resistivity. The La^{3+} additive also enhances domain reorientation resulting in square hysteresis loops, low coercivity, higher coupling factors and reduced aging. PLZT materials are applied in high sensitivity applications such as hydrophones, sounders and loudspeakers. This paper describes technological process of obtaining as well as electric properties of PLZT ceramics. Polycrystalline samples of PLZT were obtained by means of a conventional ceramic sintering (CCS) method, using the following chemical composition $Pb_{1-x}La_x(Zr_yTi_{1-y})_{1-0.25x}V^B_{0.25x}O_3$ where: $y = 50\%$ of Zr, $5 \leq x \leq 20\%$ of La and V^B – vacancies in the place B in ABO_3 structure.

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113. Synthesis and properties of (Pb,Ba)(Zr,Ti)O₃ ceramics for piezoelectric applications

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The $(Pb,Ba)(Zr,Ti)O_3$ ceramic system is generally thought as a solid solution of the subsystems $Pb(Zr,Ti)O_3$ and $Ba(Zr,Ti)O_3$. In the present work the $Pb_{0.84}Ba_{0.16}(Zr_{0.54}Ti_{0.46})O_3$ solid solution has been synthesized by mixed oxide method. The process of preparation was investigated by X-ray diffraction method, and simultaneous thermal analysis. The hot pressing method was used for densification of ceramic samples.

AC impedance spectroscopy combined with standard analytical measurements such as X-ray diffraction method, scanning electron microscopy and thermal analysis was used to study the properties of PBZT ceramics within the temperature range including the phase transition region. The data validation was performed on the basis of the Kramers–Kronig relations. The usual representation (i.e. $\text{Im}Z$ vs. $\text{Re}Z$;) as well as the alternative representations of the impedance measurement was used to interpret the impedance spectra of PBZT ceramics. Impedance spectra were analysed by means of non-linear least-squares fitting of equivalent circuits in order to obtain separate contributions of the bulk, grain boundary and electrode processes in vicinity of the phase transition region.

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114. Universal digital system for coded transmission

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A novel digital system for coded transmission was designed. Universal digital transceiver module will be a front-end for fully digital software-based coded transmission system. The developed device consists

of an arbitrary coder for transmission of coded signals and a high speed digitizer for received echoes, both working with up to 200MSPS rate. The coder can generate arbitrary waveforms including frequency (eg. chirp) and phase (eg. Barker, Golay) modulated coded signals and also supports dual transmission for Golay codes. The high speed digitizer with internal 8k samples buffer memory enables direct RF sampling on the line-by-line basis. The module communicates with PC via a high-speed USB 2.0 interface and allows streaming of digitized samples at the 20–30 MB/s rate. The device is fully programmable from a PC (including transmission/acquisition parameters and synchronization) thanks to FPGA (Field Programmable Gate Array) chip which is the heart of the system. Module will find application in standard and high frequency (20–30 MHz) ultrasound imaging, using coded excitation and enabling the real time imaging with full RF digital signal processing implemented in PC software.

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115. AC impedance studies of Aurivillius-type ceramics

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The Aurivillius family of layered bismuth oxides is currently one of the most important classes of ferroelectric material, being studied for their potential in information storage systems. Structurally they may be described as regular intergrowths of alternating perovskite-like and fluorite-like layers, with general composition (An-1BnO3n+1)2- and (Bi2O2)2+, respectively. In the present study the synthesis of mixed bismuth layer-structured oxide of the molecular formula Bi5Nb3O15 was under investigation. The mixed-oxide method followed by the ordinary firing was utilized to fabricate ceramic samples. AC impedance spectroscopy was utilized for characterization of electrical behaviour of the ceramic material for temperatures up to $T = 600°C$. The impedance spectra were recorded automatically over the heating cycles at programmed temperatures after 15 min of temperature stabilization. Impedance at every frequency was measured until consistency was achieved. The Kramers–Kronig data validation test was employed. Apart from the Nyquist (i.e. $Z\backslash"$ vs $Z\backslash'$) and Bode (i.e. $|Z|$ vs. frequency) plots, the alternative representations of impedance spectra were used to reveal contributions with relatively small differences in relaxation frequencies.

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116. Determining the distribution of acoustic field of ultrasonic multi-element probes

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The paper presents a universal method of determining the distribution of acoustic field of multi-element probes designed for application in ultrasound transmission tomography (UTT). This method allows us to calculate the acoustic field for different sectors of the probe with assigned geometry of elementary transducers' location. The idea is to sum the acoustic fields generated by all elementary transducers with the use of geometrical transformations of coordinates of location of the discussed points in the acoustic field against each of the transducers. In order to verify the calculation results, measurements of acoustic field distribution were also carried out for selected sectors of these probes. On the basis of an analysis of calculation results, the size of electronically switched transmitting sector was optimized (in the sense of the number of concurrently radiating elementary transducers) for a linear and a ring ultrasonic multi-element probes, from the point of view of their use for visualizing the inside of a biological structure by means of UTT.

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117. Sol-gel derived (Ba,Sr)TiO3 thin films for tunable devices

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In the present work the process methodology was optimized to synthesize thin films of $(Ba_{0.6}Sr_{0.4})TiO_3$ (BST) chemical compositions. The BST thin films were deposited on stainless steel, substrates by the spin coating of the multicomponent sol prepared using barium acetate $(Ba(C_2H_3O_2)_2)$ strontium acetate $(Sr(C_2H_3O_2)_2)$, and tetrabutyl titanate $(Ti(OC_4H_9)_4)$ as starting materials. Glacial acetic acid (CH_3COOH) was used as a catalyst, whereas n-butanol $(CH_3(CH_2)_3OH)$ was used as a solvent. The heating schedule of the film was decided on the thermal analysis of BST gel. Films were characterized in terms of their structure (X-ray diffractin), microstructure (atomic force microscopy) and dielectric properties at low frequencies (impedance spectroscopy) and microwaves (scattering matrix coefficients measurement). The high tunability and low dielectric loss of these films make them attractive for fabricating tunable dielectric devices.

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118. Automatic measuring system for acoustical devices calibration in the free-field

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With the introduction of new standard PN-EN 61672-2:2005, concerning sound level meters and requiring a lot of measurements to be made, a need for an automatic method of calibration arose. The hitherto applied measurement system was replaced with the new automatic system based on computer software PomAk. With the newly introduced method, a number of sound level meters and microphone calibrations were conducted, all of them fully satisfying, both due to their accuracy and speed. The capabilities of the software, calibration results and their verification are presented in this paper.

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119. Effects of γ irradiation on the electric conductivity of PZT ceramic system

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In the work, the results of investigations of the electric conductivity σ of the PZT ceramics with the two following compositions: $Pb_{0.94}Sr_{0.06}(Zr_{0.5}Ti_{0.5})O_3$ + 0.25% wt. Cr_2O_3 (hard material) and $(Pb_{0.9}Ba_{0.1})$ $(Zr_{0.53}Ti_{0.47})O_3$ + 1.67% wt. Nb_2O_5 (soft material), are presented. The "soft" ceramics is characterized by high electric values ($\varepsilon_{33}^T/\varepsilon_0 > 1300$ (in the room temperature), $d_{31} = 120 \cdot 10^{-12}$ C/N) and electromechanical coupling coefficient ($k_p > 0.5$). Due to good parameters it is used in electromechanical transducers of low frequency. The "hard" PZT ceramics, which is used in resonators, filters and ultrasound transducers is

characterized by the following parameters: $\varepsilon_{33}^T/\varepsilon_0 > 900$ (in the room temperature), $d_{31} = 65 \cdot 10^{-12}$ C/N) and electromechanical coupling coefficient $k_p > 0.35$.

The temperature dependences of the electric conductivity σ for all samples before and after γ irradiation with a dose of 20 kGy were performed. On the basis of the $\ln\sigma T = f(1/T)$ dependencies, the activation energy E_a was calculated.

Hydroacoustics

120. Bistatic systems

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This paper outlines key features of a bistatic operation in the hydroacoustic systems, performance model of the bistatic system and constraints imposed by environment and propagation conditions in shallow water. The paper provides an overview of bistatic systems architecture, their features and requirements related to high probability of detection, performance efficiency and coverage of the protection area. The application of bistatic systems, especially in protection systems, as barriers protecting anchorage or harbour, barriers protecting straits or entries to the harbour, has been shown. Attention was paid to the possibility of cooperation among the existing, commonly available sonars and bistatic acoustics devices. In addition, the design of bistatic acoustic devices in the form of transmitting/receiving module and its application in the hydroacoustic systems have been also presented.

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121. Underwater communication using acoustic phase conjugation method

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Intersymbol interference due to multipath propagation and fast channel variations is the major challenge for practical implementation of coherent underwater high speed communication to the long distance. This paper investigates the characteristics of the shallow water acoustic channel as a medium for digital communications and presents the results of basic research on phase conjugation method for coherent underwater acoustic communication. Phase conjugation or time reversal waves enable a desired signal to converge to the focus even in unknown and inhomogeneous media. In this method, the reflected and refracted waves are converged to the focus. These properties suggest that this technique may be used as a self-adaptive way of eliminating intersymbol interference in underwater acoustic communications. Phase conjugation uses time reversal to remove intersymbol interferences for acoustic communications in multipath environment. Simulation results show that the proposed technique may be utilized effectively in underwater long horizontal communication in shallow water channel.

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122. Visualisation in a passive sonar with towed array

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The paper is based on last year's invited paper submitted to the OSA on visualisation in today's active underwater acoustic systems. The present paper concerns visualisation on the monitors of a passive sonar,

which the Department is modernising, with a long acoustic array, towed along the stern. The paper begins with an overview of the design of the sonar and the method for collecting signals and the nature of the signals, which is the basis for how the visualisation is organised. More factors are described, which have an effect on the layout of the visualisation, e.g. the tasks of the operators, the organisation and display of the settings, displaying the readings of additional sonar sensors, interaction with other ship's systems, operator training and ergonomics. Examples of visualisation are included.

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123. Application of passive mode detection in the active sonars with cylindrical antenna

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In the contemporary active sonars based on digital signal processing, it is sometimes possible to introduce supplementary function' passive detection and taking bearings of sound sources. The article show the method of introducing passive mode with the sonar with cylindrical underkeel antenna without interfering into sonar structure, but by application of adequate software only. The paper present work principle and structure of applied passive system and signal processing algorithms. These make it possible to obtain the required number of beams obtained in the band of sonar receivers.

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124. Application of the gold ring bundles for innovative non-redundant sonar systems

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The paper involves techniques for configure linear, planar or three-dimensional space-tapered arrays of radar or sonar system, using novel designs based on the Perfect Combinatorial Sequencing Theory, namely the concept of Gold Ring Bundles (GRB)s for finding the optimal placement of array antenna elements in the system with respect to minimizing side lobes, while maintaining or improving on resolving ability and the other significant operating characteristics of the system. It is shown that the method provides many opportunities of the concept for configure of non-uniform array with non-redundant aperture of array systems, including acoustics and hydroacoustics.

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125. Digital monopulse method for sonar with cylindrical array

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The paper presents a method of improving the precision of bearing in multi-beam sonar with cylindrical array. The proposed method bases on the monopulse technique used in radars and sonars, where bearing of the detected target is measured with required precision within one signal transmission. In the method,

two additional deflected beams are created in the beamformer. Simple operations on signals received in the beams are performed, giving good results even in the case of low signal-to-noise ratio.

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126. Advantages of using range stacking algorithm in SAS processing

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Synthetic Aperture Sonar (SAS) processing is continuously developing in the direction of better, more effective and accurate algorithms. It is preferable to use algorithms which don't introduce any additional errors because of phase approximation or digital data interpolation. One of them is Range Stacking. In the paper, a short analysis of this algorithm, emphasizing its advantages and disadvantages in comparison with another reconstruction algorithm called Omega-k, are presented. The simulated SAS raw data for the stripmap mode, after extraction of the echoes from the finite seafloor area (spatial filtering) by means of Polar Formatting, are processed via the Range Stacking. The results of the numerical simulation are shown and discussed in this paper.

Room Acoustics

127. Modeling of the room's acoustics with the low frequency harmonic disturbance source

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In this paper, the example of the solution of a room's acoustics problem has been presented. Modeling and simulation of the acoustic field in the irregular shape of a room, such as a room in a flat, office, etc., with the low frequency source of the harmonic acoustic disturbance (60–1000 Hz), have been shown. The presented model was prepared with Femlab software, using an acoustic module. The specific abilities of the Flemlab software as the acoustic domain, the boundary conditions and harmonic disturbance source modeling have been introduced. Two kinds of results of the analysis have been presented. The eigenvalue analysis of the room model, i.e. frequencies together with the corresponding spatial distributions of modes, were obtained. In the second part, the time-harmonic analysis of the room with harmonic disturbance source inside has been conducted. The influence of the acoustic source was considered and the results were presented. In conclusion, the simulation results and the real room acoustic field measurements obtained by means of the Pulse system have been compared.

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128. Modernisation of the technical acoustics laboratory

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Educational function of laboratories requires that they should make it possible to present the measurement systems, the objects under study and the measurement results. This paper describes a concept

of modernisation of the Laboratory of Technical Acoustics at the Department of Mechanics and Vibroacoustics, where the materials earlier used for studies have been employed as the interior outfit. The walls, ceilings and floors have been resurfaced and special doors and acoustic screens have been installed. Manufacturers and distributors of these materials actively participated in the studies. The modernisation has resulted in an aesthetic interior outfit and, primarily, teaching systems presenting up-to-date possibilities of acoustic outfit tailored to various functions of rooms.

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129. A uniplanar manipulator for precision acoustic studies

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Directional studies of acoustic systems and acoustic transducers require considerable precision of orientation combined with co-ordination of control and measurement processes. The paper describes a manipulator designed and built by the authors. The manipulator is so designed that it allows precise rotation of the studied sample by means of the digital remote control of the rotation angle. The design makes it also possible to transmit static and dynamic loads suited to the character of the laboratory task. The method of control and data collection from the manipulator via an RS-232 port should also be noted. It is also possible to communicate with the plain table through LAN.

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130. Sound insulation studies of small-size samples

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The main problem in sound insulation studies of small samples in a typical system of coupled chambers is the need to construct an expensive mask with a size corresponding to that of the measurement window. This paper describes a system for sound insulation studies of small samples, which was designed and built by the authors of this paper in the existing reverberation chamber. To obtain the required volume needed to produce the acoustic pressure acting on the sample, the space in the corner of the existing reverberation chamber was enclosed by a special partition. The partition wall had a laminar structure and was equipped with a replaceable measurement window. Thus the constructed system makes it possible to assess sound insulation of small elements. Analysis showed that the measurement results were reproducible and comparable to those obtained by the classical method in the frequency range above 250 Hz. Further work will focus on developing a method that would increase comparability of the results with the classical method.

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131. Acoustical recommendations to interior design of Concert Hall at the Academy of Music in Gdańsk

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The hall with a volume of 3800 m^3 and an auditorium of 441 seats is situated in a newly designed building adjacent to the existing building of the Academy of Music. The paper describes the hall shape determined at an earlier stage of the design, the use of sound absorbing and reflecting materials, as well as the layout of sound reflecting screens. The hall is intended for performances of symphonic music and large vocal forms, operatic music in reduced scenography, as well as for teaching of symphonic orchestra recording.

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132. The effect of modal localization on reverberant energy decay in a case of two acoustically coupled rooms

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In the paper a modal analysis was used to describe the reverberation phenomenon in an irregularly shaped room. A theoretical model was limited to low sound frequencies, when eigenmodes are lightly damped, thus they may be approximated by normal acoustic modes of a hard-walled room. A utility of this method was demonstrated in a numerical example where the room in a form of two acoustically coupled rectangular subrooms was considered. A reverberation time was evaluated individually for each subroom from time decay of acoustic pressure amplitude for different distributions of absorbing materials of room walls and various positions of sound source under the condition that a total room absorption remained constant. Calculation results have shown a great influence of modes localization on the reverberant energy decay for a large difference between the absorption coefficients of walls in subrooms, because in this case for frequencies of some localized modes, a substantial increase in the reverberation time was observed.

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133. Frequency dependence of acoustic pressure distribution in a system of two connected rectangular rooms

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Sound modeling in coupled rooms has attracted considerable attention in the past, because examples of coupled rooms are theatres with boxes which communicate with the main room through relatively small apertures only, or churches with several naves and chapels, but accurate and operational models are still needed. In this paper, a combination of classical modal analysis with numerical implementation was used

to predict the acoustic pressure distribution in a steady-state inside the room consisting of two rectangular subrooms separated by an open area. The results of calculations, performed for different distributions of absorbing materials on subrooms walls, showed how various locations of the material can effect the dependence of pressure distribution on the frequency of sound source. The cases of large difference between absorption properties of materials on subrooms walls were analyzed in more detail, because in these cases the frequency dependence of pressure amplitude possessed several peaks due to the effect of modes localization.

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134. Evaluation of acoustic and architectonic parameters of chosen church buildings in Nowosądeckie region

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In view of the acoustic problems that have arisen in newly-built churches recently, an attempt has been made to establish architectonic and material parameters which have a decisive effect on acoustics of these buildings. Eleven churches in the Nowosądeckie region were chosen for the test. The churches were built of different materials (from wood to concrete) during the last several hundred years (from the 16th till 20th century). Also, the volumes and areas of these buildings were various. The research concentrated mainly on the natural acoustics of the churches, without consideration of modern electro-acoustic solutions. In the buildings, impulse responses were registered, and consequently the series of acoustic parameters (STI, EDT among the others) were determined from them. The measurements have shown, first of all, inappropriate parameters of churches built in present times. The buildings should undergo a thorough acoustic adaptation, with implementation of materials with increased sound absorption coefficients. This would improve the quality of human speech and the transmitted sounds of music.

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135. Numerical analysis of induction the reverberation time on the parametric acoustics in room

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In this paper induction of the reverberation time on the Speech Transmission Index (STI) and Definition (D50) was described. The induction was carried with the use of analytical dependences, which were obtained experimentally and by computer simulation. Analytical equation Speech Transmition Index was taken according to the paper [1], and Definition according to [2].

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136. On the problem of spatial perception of sound in rooms

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In this work spatial properties of the human auditory system subjected to complex acoustical signals are studied. A principle of equivalent acoustical powers for spatial signals is formulated and verified in an

original psychoacoustical experiment. The role of spatial perception of sound in room acoustics is pointed out. A method of spatial corrections of room reflectograms is proposed and applied to evaluate acoustical conditions in the rooms.

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137. Reverberation time of Wrocław Opera House after restoration

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One of the main acoustic goals set prior to restoration work in the Wrocław Opera House in 1997 was to increase the auditorium's reverberation time. Now, after completion of the restoration work, comprehensive acoustic investigations of the Opera House, including the reverberation time, were carried out. Measurements were performed in accordance with the ISO 3382. The reverberation time measurement results were analysed with regard to the absorption coefficient of seats. After the seats were installed, the effect of acoustic coupling with the stage and also the position of the orchestra pit's movable floor was investigated. The effect of location of a sound source (on the stage and in the open and covered part of the orchestra pit) on reverberation time was examined. The differences in reverberation time between the measurement locations were compared with the differences in reverberation time between the sound source locations. The current and pre-restoration reverberation time values were compared. It was found that the acoustic goal set for the restoration of the Opera House was achieved.

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138. Logatom's intelligibility in a room with respect to traffic noise transferred through an open window

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This study examines the perceptual effect of traffic noise (open window problem) on logatom's intelligibility. Traffic noise (European Standard EN 1793-3) was added to the phonetically balanced 100-logatom lists and was generated in two geometrically identical sound fields (with different absorption) and in the anechoic chamber. A procedure for listening difficulty, scoring and listeners' selection based on the psychometrics test was proposed. The experiment has been performed under various conditions of signal-to-noise level difference (S/N = -3, 0, +3, no noise). The effects were quantified in terms of (a) logatom intelligibility scores for young normal hearing listeners (YNH) in a binaural presentation and (b) "ease of listening" based on the time of reaction.

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139. Generalized sound wave propagation problems – new perturbation methodology

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The aim of the paper is to present applications of the new algebraic system theory in acoustic problems. Elements of new types of perturbed ordinary and partial differential equations are discussed. The new

formulation is applied to the analysis of perturbed wave problems, with perturbations in parameters as well as in initial and boundary conditions. Classical perturbation acoustic problems described by differential equations can be solved in the new algebraic system as easily as usual. Any additional analytical transformations are not required. A novel 2D ray-tracing model of detailed representation of the indoor/outdoor environment is presented. Perturbation ray tracing method is a technique based on geometrical optics, with perturbation in parameters which can be an easily applied approximate method for estimating perturbation problems in acoustics. The developed algorithms use the new perturbation methodology where the perturbed images are used to produce 2D – field of illumination zones. It can be easily considered how perturbations (small) of nominal parameter values can change solutions of the considered problems.

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140. Rational creation of acoustical conditions – an important aspect of modern classrooms design

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Nowadays, the traditional lecture-style teaching (teacher's blackboard didactic) in schools is planned to be supplemented with teacher's "mat" work (teacher's walking around) and group work. Therefore, acoustical design of classrooms must consider what teaching activities occur inside the rooms during the course of a school day. However, little is known about the impact of acoustical properties of classrooms on the effectiveness of different teaching styles. In the present paper, a concept of rational creation of acoustical conditions in classrooms suitable for many teaching styles is described. In order to demonstrate the subsequent steps of this approach, a rectangular classroom is considered. To estimate acoustical conditions in the classroom, the acoustical parameters, important for speech and noise transmission and perception, are numerically calculated for different teaching styles (teacher's position and pupils activities). Comparative analysis of the calculated parameters is presented. Practical recommendations for rational acoustical design (optimal absorptive configurations) of classrooms are suggested.

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141. Simplified model of flanking transmission of impact sound according to PN-EN 12354-1:2002 in the context of field measurements of sound insulation

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This paper presents results of estimation of weighted apparent sound-reduction index between the rooms, executed according to the simplified model PN-EN 12354-1:2002. The calculations are compared with the results of field measurements of the above-mentioned indexes. Researches executed in block of flats and hotel. In many cases come across in practice, restriction of calculation model in PN-EN 12354-1:2002 exclude this method. This paper tries to answer for question how important for precision of results are obey the guidelines.