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Abstracts

Similarities and Differences of Physicochemical Properties of the di- and triacylglycerols under High Pressure Calculated from the Results of Ultrasonic Measurements

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Two samples of triacylglycerols i.e., olive oil and triolein, and one sample of diacylglycerol were investigated. In the course of compression, the density of the samples was determined by measurements of the change of piston position in pressure chamber and volume correction due to chamber expansion under pressure. The speed of sound was calculated from the time of flight of ultrasonic impulse between emitting and receiving transducers placed in the high pressure chamber. The adiabatic compressibility, intermolecular free length, molar volume, van der Waals' constant b and surface tension were calculated from the density, speed of sound and average molecular mass. All tested liquids undergo the high-pressure phase transition. Discontinues of the measured isotherms of the physicochemical parameters of the investigated oils indicate the presence of the high-pressure phase transitions. Moreover the change of pressure during the phase transition was measured. The fundamental difference in molecular structure of these acylglycerols influences significantly on their behavior under high pressure.

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The Simplified Method for Measuring the Improvement of Impact Sound Insulation of Floor Coverings

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Laboratory measurements of reduction of impact sound pressure level according to PN-EN ISO 10140-3 standard are difficult in realization. In order to fulfil basic methodology requirements they are performed using two chambers coupled vertically, which the upper is called source room and the lower – receiving room. These chambers are separated by a 140 mm thick reference floor made of concrete, on which the resilient surfaces are laid. In Poland only one research facility may carry out such measurements. This paper describes preliminary studies which are the basis for design an impact sound reduction test stand based on the devised simplified method. Author using the Statistical Energy Analysis shows that the improvement of impact sound insulation by floor coverings depends primarily on the parameters of the sample. Moreover, during the measurements the type of a chamber plays a secondary role. This thesis was also confirmed by in-situ measurements carried out in two different rooms.

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Model Studies of Sound Absorption Coefficient of Periodic Structures

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Basic theoretical considerations concerning the determination of sound absorption coefficient values assume that for the plane wave incident at an angle θ the reflected wave is also a plane wave reflected specularly. This assumption is true for isotropic, homogeneous and infinitely large planar surfaces. However, for spatial elements or flat surfaces possessing superficial impedance that periodically fluctuates, the reflected wave is a sum of n plane waves reflected at angles θ_n. In this case, the formula for a sound absorption coefficient $\alpha = 1 - |R|^2$, where $|R|$ is the magnitude of reflection coefficient is simplistic. In the paper the authors present a distribution of the sound field in front of different periodical surfaces for a plane wave oblique incidence. It was based on an analytical solution and numerical simulations using finite element method. Furthermore, taking into account the type of reflected waves the values of a sound absorption coefficient for the analysed structures were determined. Presented studies are the basis for mod-

elling the sound absorption coefficient of perforated panels and spatial structures, i.e. baffles, audience-seats or diffusers.

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Comparison of Sound Absorption Ratings Calculated According to ISO and ASTM Standards

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Sound absorption coefficient is a crucial factor influencing reverberant room condition. Hence it is very important to accurately determine the most sound absorption single number rating. Presently, the European ISO Committee is working on the new EN ISO 11654 standard in order to improve currently used ratings. There are different standards comprehending the same products' range used in Europe and North America. Legitimacy of diversified standardization systems can always be questionable when it comes to the comparison of the results they provide. This paper presents sound absorption ratings, such as S_{AA} and α_w, calculated according to American and European standards (ASTM C423-09a and EN ISO 11654:1999, respectively), also with the account taken into the draft of the new EN ISO 11654 standard. The comparison let to find which of those reflect absorption curve, thus sound-absorbing properties the most accurately, how the differences can change the perception of the results and how new ratings proposed in the draft of EN ISO standard complete current description.

Keywords: sound absorption, rating, sound absorption average, weighted sound absorption coefficient, standards, ISO, ASTM.

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Research on Environment and Aging on Sound Absorption Coefficient Value of Materials that Have Application in Noise Reduction in Automotive with the Use of Impedance Tube

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Sound absorption coefficient determines the absorption of any room, including car interior. Long-term vibration, humidity, temperature or pollution can influence on microstructure of materials, that sound absorbing elements of car interior are made of, what could change the sound absorption coefficient as well. The article review showed that there is not many publications concerning the influence of above mentioned factors on sound absorption coefficient. This is caused mainly by the fact that producers focus on acoustic requirements of new material instead of forecasting of acoustic parameters change during the passage of time. The influence of aging and environmental factors that occur in a car during typical exploitation on acoustic properties is not controlled. For this reason even several years old car can change its acoustical properties if was subjected to adverse conditions during exploitation.

The aim of this research is to improve the control over the sound absorption coefficient during long-term vehicle exploitation and the possibility to product materials that are more resistant to adverse processes that occur during vehicle's life. The research will allow also to determine which physical factors influence acoustic parameters mostly. To determine the influence of environment and aging on physical sound absorption coefficient in the range of 50÷6400 Hz first there are planned measurements for samples taken from new materials. After this measurements samples will be subjected to tests such as aging in temperature chamber, compression, vibration, dust pollution and then sound absorption coefficient will be measured once again. These tests will be performed on materials that are used in sound absorbing elements of engine compartment and car cabin. The materials will be chosen based on their influence on total absorption of sound in a car. The measurements of sound absorption coefficient will be performed on two microphones impedance tube with the use of transfer function.

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Analysis of the Musical Tracks Based on the Acoustic Parameters

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The paper presents the analysis of the musical tracks to find the most similar ones and be able to model the musical taste of the human listener. The time and frequency parameters (such as the rhythm and amplitudes of spectrum bands at specific frequencies) are considered to determine the most significant ones for the task. The distance-based classifier was constructed and tested on the large set of mp3 and flac files belonging to various genres of music. The obtained results show usefulness of the approach to categorize specific songs and be able to find similar fragments, leading to understanding the musical preferences of the particular listener.

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Influence of Bit Rate on AAC Encoded Speech Intelligibility

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The speech intelligibility is an important factor in the speech transmission telecommunication systems. It is under influence of many factors, such as: telecommunication channel suppression, noises, delays, etc. and finally the applied encoding technique. In this paper the attention was payed

to one particular technique: AAC (Advanced Audio Coding), which is used among others in DAB (Digital Audio Broadcasting). Depending on the bit rate score used, different quality and intelligibility is obtained. From the band usage point of view the best is the lowest bit rate. One of the techniques allowing the validation of speech quality on the basis of intelligibility criterion is the logatom intelligibility measure. The aim of the tests was to settle the minimal bit rate score which can ensure satisfactory speech intelligibility. As a result of the carried out experiments the minimal value of bit rate score from which satisfactory results are obtained was settled out.

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An Influence of the Walls Acoustic Impedance and Acoustic Frequency on the Mean Acoustic Pressure Level: Fourier's Solution

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The Fourier method is applied to the description of the mean acoustic pressure level in a room with uniform, impedance walls. All possible values of the impedance and chosen acoustical frequencies are considered. The representative, rectangular cross section of the room is assumed. The acoustic force constitutes the cross section of the pulsating line acoustic source. It is proved that the Fourier method provides a useful and efficient approach for an acoustic estimation of the room with different values of wall impedances and different frequencies; it was the aim of the paper. The expected results are confirmed by numerical calculations.

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Influence of Sound Source Height in Orchestra Pit on Sound Strength G. Test on Model in Scale 1:50

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In recent years, many researchers use to evaluate the acoustics in room sound power G. This parameter quite well in terms of evaluating both the audience and the musicians on stage or in the orchestra pit. Research on the scale model made it possible to include all acoustic phenomena, among others, diffraction at the edge of the barrier or the effect of coupled rooms. This phenomenon has a significant influence on the sound strength G as shown by the number of measurements in real rooms. Both of these effects are difficult to include in software based on geometrical methods, image sound sources, etc. The results obtained during tests carried out on the model in 1:50 scale. The model was constructed based on the actual hall of the Kraków Opera.

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Analysis of Possibility of Mechanical Crosstalk Minimization in Linear Ultrasonic Array Based on FEM Modeling

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Mechanical crosstalk are caused by propagation and overlapping of different modes of vibrations (longitudinal, transverse, and surface waves, Lamb waves) through structural components of the transducer array, such as backing layer, front layers, transducer mounts. This phenomenon distorts the directivity pattern of the array and as a result impairs the quality of ultrasonic images. The problem is significant in the design and fabrication process of such arrays. It intensifies in case of arrays with a large number of elementary piezoelectric transducers, which are used for focusing and precisely steering the beam of ultrasonic waves. The usage of Finite Element Method (FEM) allows to examine the different modes of vibration, identify their ways of propagation and evaluate their participation in the crosstalk signal. An important aspect is also a relatively fast and easy way to predict specific design changes which influence the formation of crosstalk. The paper proposes several ways to minimize mechanical crosstalk in a linear array of ultrasonic transducers through the introduction of appropriate changes in structural elements in a model of the array. These changes were analyzed with simulation of vibrations and crosstalk using FEM method.

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Impact of Urban Transport Vehicles Noise on the Acoustic Climate in the Immediate Vicinity of Bus Stops

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Traffic noise is a common part of the interest of vibroacoustics. In urban areas traffic is one of the main noise sources. Some problems for the acoustical climate in the neighbourhood of the bus stops will be reviewed, like a noise source identification and the measurement methodology. The results of the sound level A measurements in some bus stops in Cracow will be presented, attempting to discuss the influence of the bus stops placement for the environment in its acoustical aspect. Different types of buses used by the Zarząd Infrastruktury Komunalnej i Trasportu in Cracow (ZIKiT) will be presented with their designated average stop arriving noise level. That data, including information about frequency and types of vehicles moving on specific bus lines, can be used for calculation the influence of the bus stops presence on the acoustical environment in different areas (open, building-close or acoustical protected areas).

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The Use of Aeroacoustic Analogies in Radial Fan Noise Modelling

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Because the fans are the most common devices in the industry a small change in their efficiency or generated noise level will give big effects for the environment. Therefore, the authors proposed radial fan noise modelling with use of Ffowcs-Williams and Hawking analogy. The results are compared with the Kirchhoff integral model. Designed models are 3D and 2D. Incompressible flow field is computed using Navier-Stokes equations, then permeable version of FW-H analogy is used. Pressure and velocity of the fluid then are used for far field sound pressure level calculations. Far field sound pressure level is estimated using 3D model and 2D model with 3D correction.

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Vibrotactile Amplitude and Frequency Discrimination on the Wrist of Visually Impaired People

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Knowledge about discriminative ability of touch is crucial when designing devices which use tactile interfaces. Such a interfaces are used for example to augment remote sensing, as in robotic, teleoperation, gaming, and a host of other important areas for example in surgery or in military. Devises which use tactile feedback are also used in sensory substitution. Paper presents results of psychophysical studies connected with vibration perception on the wrist of blind and partially sighted people. The presented research examined the ability to identify the changes of amplitude and frequency of vibration on the wrist. Research was carried out on students of Special Schools for the Blind and Partially Sighted Children in Kraków. 30 blind, partially and normal sighted persons were examined. Transformed up/down method was used to determine vibrotactile amplitude and frequency discrimination threshold. Thresholds were obtained on the ventral wrist at 5 frequencies: 25, 32, 63, 125 and 250 Hz. Results were examined to find factors which could influence threshold value.

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Indirect Measurement of Equivalent Viscoelastic Parameters of Loudspeaker Diaphragm with Complex Structure

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The measurement method of equivalent dynamic Young modulus and damping factor of complex structure used for manufacturing of loudspeaker diaphragms is presented in the paper. The diaphragm in the form of conical shell of revolution with honeycomb structure was the object under investigation. The given parameters of the diaphragm are its mass and geometry. The boundary conditions were: clamping on the inner rim and free on the outer one. The vibration of the structure has been measured using laser Doppler vibrometer and modelled using the FEM method. The dynamical Young modulus and damping factor have been determined by the comparison the results obtained from the model and from the measurements. The calculated and measured quantities are resonant frequencies and quality factors of the resonances. The accuracy of proposal method is also discussed.

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Speech Transmission Index in the Context of the Technical Specifications for Interoperability of the Rail System in the European Union

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According to the regulations in force in the European Union, spoken information in range of the railway infrastructure and rolling stock should provide adequate speech intelligibility. The paper proposes the details of the measurement procedure that allows confirmation of compliance with these requirements. Such aspects of procedure as calibration of test signal level, selecting measurement positions, levels and spectrum of background noise and evaluation indicators are discussed. Results of measurements performed inside of railway vehicles and on platforms are presented. Reasons for which tested systems do not meet the requirements are shown and basic guidelines for designers of public address systems are presented.

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Grid – a New Fast Tracking Procedure for Determination of Psychoacoustic Thresholds

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A new procedure is described that allows rapid acquisition of threshold curves for psychophysics and, in particular, psychoacoustic, experiments. Because of changing the way the parameter-response space is sampled, the procedure focuses more experimental time investigating the vicinity of the sought-after threshold curve, compared to the current state-of-the-art methods. Therefore, time-efficiency is significantly increased and may be suitable for clinical diagnosis. While the described procedure can be used to track threshold curves in various psychoacoustic experiments, its use for measuring temporal masking curves (TMCs), based on forward masking is presented as a working example in the present study. Thresholds obtained in

TMC experiments using a standard adaptive method and the new method are comparable (i.e., very highly correlated).

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Localization of Acoustic Sources Using a One-channel Time Reversal Method: a Study with FEM

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This study investigates a problem of an acoustic sources localization inside an acoustic cavity by processing measurement data from a single sensor with the use of time reversal (TR) method. Presented method is based on the principle of time-reversal invariance and spatial reciprocity of the acoustic wave equation in a lossless medium. In a classic experiment, the acoustic waves propagated from a point-like source can be refocused in the original source location if the output measured by a set of transducers is time reversed and re-emitted back. A perfect localization would require an array of sensors totally enclosing the acoustic cavity, which is very difficult to obtain in practice. Sensors are often arranged in a time reversal mirror (TRM) of finite aperture and bandwidth that limits the focusing quality. There are studies showing that reverberations of a diffuse wave field in a complex medium enhance the focusing resolution of the re-emitted signal. This phenomenon, called super-resolution, is mainly due to the presence of scatterers within the medium that allow the evanescent modes (waves that decay exponentially with the distance to the source) to be converted into propagating modes. These waves, carrying the information of the acoustic source to the far field, where the TRM is located, can participate to the focusing process. The result of such operation creates a virtual sound sources and the number of the TRM transducers can be drastically reduced, even to a single transducer. Research is conducted as a FEM modelling for preliminary determination of the capabilities and accuracy of TR method in selected acoustic medium geometry and configurations of the transducer location.

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A Research Study of an Absorbing Structure Dedicated to Anechoic Chambers

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Sound-absorbing structures are the most important elements that form the sound field in anechoic chambers. Depending on the purpose of a chamber, these structures could take various shapes. The most popular are sound-absorbing wedges which specific acoustic properties are achieved based on scientists broad knowledge and research results. Due to modernization of the anechoic chamber placed in Department of Mechanics and Vibroacoustics AGH in Kraków, a series of studies were undertaken in order to develop the best suited sound-absorbing elements. The article presents results and interpretation of studies carried out in the impedance tube which was specially designed and constructed based on the PN-EN ISO 10534-2 standard. The studies allowed to analyze impact of material type, geometry, coverage and mounting on wedge acoustic properties. The selected structures were produced and mounted in the anechoic chamber and tested in accordance with the procedure described in PN-EN ISO 3745 standard.

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Thermocouple Measurement of Temperature Variations in Soft Tissue Phantoms versus Backscattered Ultrasonic Signals Properties

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The aim of the work is to find the relationship between temperature changes in soft tissue phantoms and changes in the envelope of backscattered ultrasound signals. The phantoms were produced from polyvinyl alcohol – cryogel (PVA-c). The different acoustical properties of phantoms result from different number of freeze-thaw cycles. The raw RF signals (radio frequency) were collected from chosen parts of phantoms subjected to heating. The heating of phantoms was carried out in a water bath for 2 h with controlled temperature increase from 20°C to 43°C. The actual temperature distribution during the heating process, in different places of the samples was measured using a thermocouples working in USB-TEMP module. Simultanously, in 5 min intervals RF signals were recorded by a ultrasonic imaging system. The system consisted of the linear imaging ultrasound transducer L14-5/38 and the ULTRASONIX SonixTOUCH (British Columbia, Canada) device. The carried frequency of transmitted signal had 10 MHz and the beam was focused at a depth of 3 cm from the phantom surface. Maps of CBE (changes in the backscattered energy), SNR (signal-to-noise ratio) and shape parameter of the Nakagami distribution, were determined from the amplitude of the RF signals. To calculate these maps the method of "moving window" of size 2×2 mm were applied. The compatibility of changes in these maps with the changes in the spatio-temporal distribution of temperature, registered by a thermocouples was demonstrated.

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Measurement of Insertion Loss of the Acoustic Microperforated Silencer

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Silencers are elements which reduce noise propagating in the duct, e.g. heating, ventilation or air conditioning systems (HVAC). The most commonly used are the absorbent

silencers made of perforated panel wrapped absorbent material. However, there are some specific cases related to e.g. the pollution medium flowing through the duct, preventing the use of this type of silencers. Microperforated silencers are an alternative way to reduce noise in these cases.

The measurement were carried out on the experimental set-up, equipped with a rotating array of point sources capable of generating a single mode in the waveguide.

The study included two positions of the point source in the waveguide, ie. axisymmetric and non-axisymmetric with an offset of half of the waveguide radius in order to excitate non-axisymmetric modes. The broadband noise excitation was used. Results of insertion loss of an microperforated silencer are presented.

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CDM Experiences and Test Result with Sport Floors

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Putting gyms and fitness rooms on internal floors always poses a great challenge for acoustical consultants. Different types of use, such as jumping (kangoo), bouncing balls, weights, represent different types of excitation, and thus require different approaches for a well-performing floating floor. Over the years, CDM, the Belgium based engineering company and supplier of noise and vibration isolation solutions, has had the privilege of being involved in a number of sport floor projects and test campaigns aiming to find answers to some lingering questions. The present article intends to give a summary of these experiences and tests.

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Vibro-Acoustic Research of Windows in the Aspect of Functional Parameters

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Nowadays, a modern civil constructions must meet increasingly high acoustic comfort parameters. On the one hand, the latest standards for the allowable noise levels and the sound insulation levels, on the other, individual demands of clients and architects. Most requirements are related to the sound protection of the inhabited premises, especially from external noise sources, i.e. the traffic (road, rail, or air), noise emission from neighbouring parcels, etc. In buildings the "weakest" acoustic element are any openings, i.e. windows embedded on all its facades. The key, to provide the required noise parameters, is the properly selected acoustic insulation, for instance windows with high acoustic performance parameters. Often, the accommodation space joinery sound insulation level, determines the successful admission of the new or refurbished buildings by the investor or the construction supervisor. The article describes vibro-acoustic research of the high performance windows. It focuses on the study of sound insulation measurements combined with the glassing vibration measurements. The series of tests concerns influence of different modifications of the window structure by applying changes in the individual components, the dimensions of the window and the type of mounting. The results of the study are presented in the form of useful tables and diagrams, to simplify the acoustic windows design process.

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Ferrofluid as a Sonosensitizer for Ultrasonic Hyperthermia

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Hyperthermia is a medical procedure that can be used for cancer treatment. In this therapy method the cancer cells are exposed to elevated temperatures, i.e., the temperatures at which the cancer cells are weakened or killed.

The heat can be created by different physical mechanisms most commonly associated with the dissipative losses occurring in the body in the propagation of the electromagnetic and the ultrasonic fields. In this work we use ultrasounds and magnetic fields for generating the heat.

In the first part, we study the effect of addition of nanoparticles to the targeted medium on the rate of heat generation by the ultrasonic hyperthermia. The particles (sonosensitizers) enhance the absorption of ultrasounds, and in turn generate the local heat. Here we use biocompatible magnetic nanoparticles dispersed in the agar gel phantom samples. The agar gel was chosen as a material for producing the phantoms to mimic human tissue, because the acoustic properties of the agar gel are similar to those of the human body tissues. We measured the ultrasonic hyperthermia of the phantoms both with and without the nanoparticles. In addition, we measured the attenuation coefficient and the velocity of acoustic waves penetrating the samples.

In the second part, we studied the magnetic hyperthermia of the samples, and also the synergetic action of the magnetic fields and ultrasonic waves to generate the heat in the samples.

The obtained experimental results demonstrate that magnetic nanoparticles are promising sonosensitizers for ultrasound-induced hyperthermia. The presence of magnetite nanoparticles in the tissue-mimicking phantom increases the absorption of ultrasound energy by the sample, leading to increased temperature. The same magnetic nanoparticles can also be used for magnetic hyperthermia – they produce heating of the sample when exposed to the alternating magnetic field. Finally, we demonstrated that the

magnetic hyperthermia and ultrasonic hyperthermia may work synergistically, rather than independently, to produce a more efficient treatment.

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Military Airport Noise Modelling

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Accurate modeling of a military aircraft noise is much more complex, than modeling of an civil aircraft noise. Three main reasons of this situation can be identified. Polish legal regulations recommends aircraft noise prediction methodology based on ICAO Circular 205 – AN/1/25/1988 document and implemented in INM software. Since this method and software was originally developed in the USA there is lack of non-NATO aircraft data in this software, and several of these aircrafts are still in use in Poland. Second reason is more complex traffic structure at the military airports compared to the civil airports. Except standard approach and departure operations there are several specific types of other training operations at the military airports. Third reason of the complexity in military airport noise modelling is that profiles of military aircrafts – specially high performance aircrafts (opposite to the civil airplanes) can significantly differ from those standard profiles implemented in INM software. Moreover this profiles can be specific to the airport regarding its location in regard to the cities, other airports etc. Present paper shows – regarding the above issues – how important is accurate calibration and validation of an military aircraft noise prediction model. Two step approach to model verification was shown. The first step is calibration by adjustment flight profile parameters and comparing prediction result with measurement for sound exposure levels of a single flight operations. The second step is validation of a model in terms of a long term noise metrics calculated and measured for complex airport traffic. Present study shows errors in noise ranges originating from using standard – instead of real departure/approach profiles. We also shoved influence of calibration measurement points locations on modelling accuracy.

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Computationally Efficient Method for Reconstruction of Sound Speed in Soft Tissues

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Information on the sound speed in the imaged region is needed for correct image reconstruction in ultrasound pulse-echo imaging systems. Such devices are widely used in medical diagnostics due to their non-invasiveness, harmlessness, versatility, time resolution and relatively low cost. However, for the purpose of image reconstruction, these devices use a sound speed value that is an average for soft tissue, which locally can be far from reality and can lead to aberrations. Development of a method for real-time reconstruction of sound speed in tissue will make possible to efficiently correct aberrations in pulse-echo ultrasound imaging. Considering the fact that it is a well established imaging technique, the efficient aberration correction method will definitely contribute to the increase in quality of the diagnostic process. Another motivation for development of sound speed imaging technique is the fact that the sound speed reflects mechanical properties of tissues. Therefore, the calculated sound speed maps may provide additional diagnostic information qualitatively similar to those obtained from elastography. Furthermore, the sound speed data can be used in a more cognitive context in research projects that require non-invasive measurements and where it is not possible to use ultrasound tomography, e.g. study of sound speed in tissues during high intensity focused ultrasound treatment. The most recent scientific reports show that it is possible to qualitatively image the sound speed distribution at low computational costs. However, attempts to transit to a quantitative sound speed imaging required a substantial increase in the computational complexity. This raises doubts concerning the application of the quantitative method in real-time imaging systems.

The method presented in this paper is based on a new mathematical model which allows for computationally more efficient solution while preserving the quantitative character of sound speed imaging. Similarly as in the case of the approaches mentioned above, the input data are low resolution images (LRI) reconstructed for a compounded plane wave imaging (CPWI) sequence. Then, based on phase relations between LRIs, one can calculate the time shifts that are a direct result of the errors in the sound speed value assumed in the image reconstruction process. Next, using the new mathematical model the time shifts are converted to sound speed corrections which finally can be applied to the initial sound speed distribution used in the LRIs reconstruction.

The proposed method was implemented and verified through a number of simulations. The obtained results are comparable to those generated by the reference algorithm – the one described in the mentioned scientific reports. The computational complexity of this new approach is proportional to N while in case of the reference algorithm it is proportional to N^2 (where N is a number of pixels in the calculated sound speed image).

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Ultrasound Attenuation Imaging of Tumor Tissue

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The ultrasound imaging (USG) is one of the most common medical imaging modality. The technique allows for non-invasive and inexpensive visualization of the internal tissue structures. Standard images show the spatial distribution of echogenicity which is related to distribution of

the acoustic impedance. Additional processing of acquired signals can provide more signal parameters which are related to physical properties of a tissue and its state. Ultrasound attenuation is related to tissue microstructure and can be used for soft tissue characterization in non-invasive manner. Such characterization is especially important for diagnostics and visualization of tumors. In our research we have applied quantitative ultrasound techniques that are based on raw RF signals processing and physical properties of tissue independent of the scanner properties and settings. Estimation of local attenuation coefficient allows for synthesis of parametric images. These images show the spatial distribution of attenuation coefficient and provide information about physical parameters of a tissue in convenient form. This additional information can be useful for medical diagnosis. The attenuation coefficient can be estimated utilizing the downshift of the central frequency of the propagating pulse. The value of the downshift is related with spectral parameters of the pulse and distribution of attenuation coefficient as well as the diffraction effects and impact of the receiving system. We have developed a modification of this approach and this modified spectral shift method was used. Our technique determines frequency shift using limited range of spectral frequencies. This approach reduces the influence of diffraction effects and noise. The results of tumors characterization using the attenuation estimate will be shown. The parametric images of the attenuation coefficient distribution in human tumor tissue will be presented and restrictions of the method will be discussed.

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Air Traffic Noise Indicators

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The growth of air traffic in recent years has led to a substantial increase of noise pollution in many Polish agglomerations. It also turned out, that applicable legislation is too imprecise in this matter. It leads to frustration of residents exposed to this noise impact on one side and blocks the development of airports on the other.

Air traffic noise is assessed in terms of A-weighted equivalent sound pressure level, L_{Aeq}, averaged over short (one day/one night, $L_{AeqD/N}$) or long (ex. one year, L_{DWN}/L_N) period. This level is determined based on traffic flow and a measure of single noise event, expressed by the sound exposure level, L_{AE}.

The L_{AE} of single air operation is simple to measure, but very difficult to calculate, due to its dependency on at least several factors. One of the main sources of uncertainty is the lack of definition or algorithm fixing so called representative air operation. What is important, the range of noise impact obtained by calculation method establishes the so called "limited use areas" around airports, which in turn give rise to compensation payment. According to the legal regulations, noise zones are expressed by daily equivalent sound pressure levels which are calculated with nearly the same uncertainty as L_{AE}, especially for night time when statistical dependencies do not work properly because of low number of aircraft operations. In case of restrictive requirements (examination of daily worst case) it is almost impossible to set representative noise scenario reliably, including noise prediction for many years ahead. That is way it is proposed to lay down daily noise assessment on the basis of long-term averaged noise levels, the same as used for strategic assessment, since it is the most probable scenario and then easiest to calculate. Such approach do not reduce or limit the intermittent controlling procedures. It still may be carried out by simple daily measurements, however the result must not exceed permissible long-term noise level by more than permissible daily deviation. This deviation is estimated in the paper, making use of long-standing continuous noise monitoring around airports.

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Measurement of Sound Absorption Coefficient of Microperforated Panel Absorbers

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Characteristic of microperforated panels (MPP) is the perforations size less than 1 mm and porosity around 1%. Microperforated panel should be fixed at some distance before a rigid surface to create air cavity. Geometric properties are chosen to create surface with a normal impedance close to the characteristic impedance in air. Using MPP absorber eliminates disadvantages of commonly used absorbers with porous materials eg. no resistance to environmental factors, dirt or fungus while ensuring broadband sound absorption. In the paper sound absorption measurement results made in the impedance tube of tens MPP samples with different parameters (orifice diameter, panel thickness, perforation ratio, cavity thickness, used material) are presented and compared with theoretical prediction based on mathematical model created by Maa (1998).

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Aeroacoustical Studies of Airfoil with the Trailing Edge Modifications

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To minimize the noise emission of the airfoil is an important issue to be considered in the design its. Solutions of the noise problems are also looking for in nature, especially in owl's. Their silent flight is possible thanks to the special structure of their feathers. Their secondary flight feathers are cut in the shape of the teeth at the leading edges and the combs of the trailing edges.

The effects of noise reducing by cutting the profile as a regular teeth of the trailing edge were been studied. The results depend on the size of the teeth, the width between the top of the teeth, angle of attack blade, Reynolds number, etc. These works concern only on the serrated trailing edge of the airfoil. In this work the noise of the flat

plate and airfoil with the elliptical, rectangular and isosceles arcs on trailing edge was studied. At lower speeds, a better noise reduction effect was obtained for the plates with edges as elliptical arcs. Potential noise reduction at low and midle frequencies was observed. Generally, a decrease in the sound pressure level was observed at lower frequencies but at higher frequencies followed an increase in the SPL.

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Index Assessment of the Influence of Occupancy on the Acoustic Quality of Selected Churches

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The article presents the analysis of the influence of occupancy on the acoustic properties of the two churches using simulation studies and the index assessment developed in previous studies and dedicated to Roman Catholic churches. Studies using developed the global index of the acoustic properties GAP and acoustic models of the churches were extended to surface distribution of the values of this index on measuring surfaces of these interiors. The extent to which changing acoustic parameters, in relation to their recommended values, of the church with unsatisfactory acoustics, when taken into consideration the presence of the audience and proposed its acoustic adaptation, was examined.

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A New Procedure for Automatic Fitting of Basilar-Membrane Input-Output Function to Individual Behavioral Data

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The basilar membrane input-output function (BMIO) in a healthy cochlea is highly nonlinear. One of the consequences of sensorineural hearing loss (SNHL) is partial or full loss of this nonlinearity. Behavioral estimates of the individual BMIO can be useful for modeling of the impaired auditory system and, potentially, for clinical diagnostics. Computational algorithms are available that mimic the functioning of the nonlinear cochlear processing. One such algorithm is the dual resonance non-linear (DRNL) filterbank (Meddis *et al.*, 2001). Its parameters can be modified to account for individual hearing loss, e.g., based on behavioral temporal masking curves (TMC) data. This approach was used within the framework of the computational auditory signal-processing and perception (CASP) model to account for various aspects of SNHL (Jepsen and Dau, 2011). However, due to the computational complexity, on-line fitting of the DRNL parameters is difficult. Until recently the parameters were manually adjusted and the fitting process was indirect. A new approach is described here, based on a search through a lookup table of precomputed filter bank input-output functions. The aim of this approach is to provide a fast, stable, and more objective fitting procedure.

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The Acoustic Properties of Thermoacoustic Devices

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Research in thermoacoustics began with the observation of heat transfer between an acoustic wave and a solid material. Using this interaction an intense sound wave could be applied to create engines as well as heat pumps. The most important part of thermoacoustic devices is a regenerator or stack, where the process of acoustic energy conversion into thermal energy, or vice versa, takes place. This phenomenon allows to exclude any mechanical parts, i.e. pistons, of the device.

The aim of the paper is to present the properties of thermoacoustic prototypes (the impact of the material used to construct the regenerator and design parts of the acoustic system). Interest in thermoacoustic converters grows steadily. The can be used to convert heat into acoustic energy or to convert sound energy into heat, which can be used directly or easily converted to electricity. So far thermoacoustic technology has been used only in the space industry. For the first time it may become applicable in a household.

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Embedded System for Fit Testing of Earplugs

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Noise earplugs are the most frequently used personal hearing protection means. Improper fitting of the earplugs is one of the most important causes of unsatisfactory protection against noise. This protection may be improved thanks to different forms of training courses organised for the workers. Present systems of testing the fitting of earplugs have been discussed in the paper. A model of a new device of the type has also been presented. Its construction has been based on a cheap and generally available embedded system. The device makes it possible to conduct tests in the environment. Selected technical solutions of the device with regard to assumptions made have been discussed.

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The Study of Noise Generated during the Passage through the Bridge Expansion Joints

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Assessment of road noise, even though it is well parameterized, does not include all of the phenomena which may cause increased annoyance. One of examples is impulsive noise generated during passage through the bridge expansion joints, the special slots located in bridge structures in order to reduce excessive deformation caused by temperature changes. The paper presents the results of experimental studies on impulsive noise generated during the passages of vehicles. The measurable parameters of such signals useful in the identification and evaluation of annoyance was presented, together with an attempt of its assessment. It was reflected, that there is need for applying an impulsive adjustment in the evaluation of road noise, both the near and further away from the bridge construction.

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The Method for Estimating First and Second Derivatives of Digital Audio Signals

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In this paper the method for estimating first and second derivatives of a digital audio signals are presented. Calculations are based on traditional central-difference formulas with modifications that minimize round-off and truncation errors. FIR filters designed with modified cosine-sum windows are utilized for interpolation and fractional delay of audio signals. This is essential for the optimal step size selection to achieve desired accuracy of numerical differentiation. The proposed method are described and results are showed and discussed. The maximum relative error of estimating first and second derivatives with the proposed method are respectively 10^{-11} and 10^{-8} in the audio band.

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Cancer Malignancy Sonic Markers

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Currently, already almost a quarter of cancer diagnoses among Polish women is breast cancer. Every year there are more than 16.5 thousand of new cases, and in the next 10 years the number of women who become sick every year, will grow and exceed 20 thousands per year. The aim of our research was to build ultrasonic biomarkers to distinguish non-invasively between malignant and benign tumors as well as to assess their degree of malignancy. For the calculations we used raw ultrasonic RF signals (Radio Frequency) collected from patients of Cancer Center – Institute in Warsaw. In the studies we used parametric maps, describing the spatial distribution of physical parameters of lesions, such as tissue attenuation, backscattering coefficient and velocity dispersion. The texture parameters of these maps were analyzed using matrix GLCM (gray-level co-occurrence matrices). The best classifier were selected and used to build complex classifiers. Their suitability for classification of changes was evaluated by methods of statistical analysis. Results (curves ROC- receiver operating characteristic) of differentiation of breast lesions based on different types of complex classifiers will be presented and discussed.

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Analysis of the Influence of Cylindrical Duct Length on the Acoustic Attenuation Performance of Selected Helicoidal Resonator

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This work presents the analysis of the influence of cylindrical duct length on the acoustic attenuation performance of helicoidal resonator. The finite length ducts are the real elements of ducted systems like heating, dedusting and air ventilating systems. The silencers are often used at the ends of this kind of systems or at the duct sections placed at the fans outlet, which are often short, as well. Also the finite length ducts determine the acoustic attenuation performance, usually insertion loss, of silencing systems. Especially, acoustic resonators and reactive silencers are sensitive on the ducts lengths. Therefore, the different duct lengths are analyzed in this work to present the influence on acoustic attenuation performance of selected helicoidal resonator. The straight duct is analyzed, as well as different ducts lengths at the inlet and outlet of helicoidal resonator.

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The Method of Supporting the Planning Activities Limiting Exposure to Noise at Workplace

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In accordance with applicable regulations in the case of exceeding the permissible noise levels in the workplace it is necessary to take appropriate preventive actions. The most preferred methods are the direct reduction of exposure to noise. This can be achieved by reducing the noise at source or reduce the time of exposure to this harmful factor. In the case of complex schedule of a working day when the employee performs many tasks with different durations, being exposed to different noise levels associated

with various sources, planning of actions towards reducing exposure to noise to the limit value in such a way that at the same time minimize the costs involved is not a simple matter. These costs relate to both the technical activities related to design modifications of noisy equipment, and organizational activities relating to shorten the duration of activities constituting the schedule of the working day of workers exposed to noise. The article presents a method that allows on the basis of the adopted scale assessment of the costs relating to the technical and organizational activities for the planning of these activities so that they result to reduce the exposure of workers to the limit value or other accepted limit. The basis of assessment used in the method is the level of noise exposure related to 8-hour working day. Based on the assumptions of the method a software tool that allows its use under practical conditions was developed. The program processes the set of measurements of noise to the form which is the basis for the assessment of exposure to noise in accordance with applicable regulations, and, in the case of exceeding the acceptable daily exposure, proposes appropriate suggestions for the reduction of equivalent sound pressure levels and durations of activities performed by employees during the work day. The program supports the assessment of noise exposure even for very complex schedule of the working day and relieve the user of time-consuming calculations related to the estimation of measurement uncertainty. The article presents examples of calculations performed using the described program.

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Properties of CW Sonar with Waveform Modulated by Pseudo Random Sequence

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Continuous wave sonar, unlike impulse sonar, can be used for quasi-continuous observation purposes and as silent sonar with a low probability of intercept (LPI) by the foreigner intercept sonar. The linear frequency modulation is applied in simple solutions of continuous wave sonar. The negative effects of this solution are distance evaluation errors due to the Doppler Effect. In order to reduce these errors authors propose to use continuous waveform modulated by pseudo random sequence, wherein the sequence elements are represented by the signals with the hyperbolic frequency modulation. Simulations showed the effectiveness of such a solution. A significant reduction of errors related to the assessment of distance, unfortunately, also involves the deterioration of some sonar parameters such as range, resolution and side lobe level of output signal. The article presents the simulation results of the relationships between the waveform parameters, and listed above operating sonar parameters. The obtained relationships can be used to optimize sonar design for different purposes and different operating characteristics.

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Wave-Based Method for Simulating Small Room Acoustics

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The wave-based method was developed for simulating acoustics of small rooms at low- and mid-audio frequencies. The method is characterized by a great versatility because it is designed for rooms of an arbitrary shape. An applied theoretical model utilizes a modal representation of the room impulse response obtained by solving 3-dimensional wave equation within a room subjected to a time impulse forcing. The method allows to determine steady-state energetic acoustic quantities, such as the potential and kinetic energy densities and the active and reactive sound intensities. It also enables to predict a decaying sound field inside a room and room reverberant characteristics. Two kinds of reverberant response were considered. In the first case, the room response was initiated by the pure-tone point source and a beginning of the reverberation process occurred just after turning off the source. In the second case, the room was excited by Dirac delta time impulse emitted by the point source. In this case, the numerical technique known as the Schroeder backward integration was applied to determine decay curves. This procedure allows a simple calculation of the decay times and enables to predict other reverberant parameters used for the objective evaluation of room acoustics such as the definition, the clarity index, the centre time and the early and late lateral energy fractions.

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Improving Acoustics of Hard-Walled Rectangular Room by Ceiling Treatment with Absorbing Material

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A rectangular room with well-reflecting walls has a number of acoustic flaws which disrupt speech and music. These include a long reverberation time, a boomy sound and the effect of coloration. A method commonly used for improving acoustics of such a room consists in increasing the sound absorption of the ceiling. In this study the impact of acoustical treatment of the ceiling on reverberant properties of the hard-walled rectangular room was examined using the wave-based model of room response. It was found that for untreated room statistical and wave theories give the same result because modal decay time for oblique modes and the Sabine's reverberation time are identical. Calculation results of modal decay times have shown that for dimension ratios typical for actual rooms initial increase in the specific wall conductance causes a considerable drop in the modal reverberation time and the efficiency of the treatment decreases with a further increase in the conductance. It was found also that this efficiency is greater for

smaller room heights because a participation of the ceiling in the total area of room walls increases when the room height decreases.

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The Relationship between Maximum Sound Level and Sound Exposure Level of Aircraft Noise – Case Study

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The paper presents the relationship between sound exposure level, L_{AE}, and maximum sound level, $L_{AF,\max}$, for an aircraft noise. The study is considered significant because, according to Polish standards, maximum sound levels are crucial magnitudes in analysis of aircraft noise impact on residential or public buildings. The majority of databases of aircraft noise are mainly derived from continuous and periodic aircraft noise monitoring. Due to the lack of legal requirements, the monitoring data do not often contain maximum sound levels. They typically contain exposure sound levels of individual aircraft operations and time courses of the linearly averaged (e.g. with 1 second step) A-weighted equivalent sound level ($L_{Aeq,1\,\mathrm{s}}$). In this study, the possibility of using time courses of the A-weighted equivalent sound level was investigated to estimate the maximum sound level for different types of air operations. As a result the empirical relationships between the maximum sound level and sound exposure level were established. The analysis took into account types of flight operations (departure and approach), types of aircraft engine (e.g. turbofan, turboprop), take-off weight and the distance between the receiver and the runway. The database of flight operations used in this study was obtained from continuous airport noise monitoring near and far from the runway threshold. For each datum collected, high regression coefficients were obtained. These results were summarized and compared to similar studies available in the literature.

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The Reproducibility of the Façade Sound Insulation "in-situ" Test Results

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Ensuring adequate acoustic comfort in the place of residence is an important social, technical, technological and economic problem. The needs of individuals in ensuring the acoustic conditions in the apartments are vary. For this reason, the requirements for acoustic comfort should be graded from a level that ensures minimal (due to physical and mental health of the population), the acoustics in the place of residence up to the higher levels corresponding to the greater needs in this area. Translating into different technical requirements for acoustic comfort in the place of residence means a finding acoustic requirements for buildings with elevated (to varying degrees) standard acoustic and how the acoustic classification of objects according to the adopted increased requirements. The answer to the demand for residential buildings with higher acoustic quality is proj. PN-B-02151-5 standard, which specifies among other course of action for the classification of sound residential buildings or separate parts or individual apartments. Acoustic tests as a basis to determine the class acoustic multi-family building, or parts of it must be carried out in respect of any consideration for protection and for each scope of protection for individual solutions covered by the acoustic requirements. The article discusses the problem of reproducibility of test results of airborne sound insulation in the context of acoustical assessment of façade of a residential building.

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A Proposal for Acoustic Classification of Dwellings in Poland

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Most products present on the market are offered in different classes, the class means specific quality but also a specific price related to it. As the quality is usually defined by several parameters a client, depending on his expectations and possibilities, can make a choice based on clearly specified characteristics. It is apparent in car industry where manufacturers give a wide range of well defined products dedicated for different customers. Dwellings are also products, very expensive, which are launched onto the market by developers. Although the price is high, their quality is not so well defined, at least in terms of acoustics. In Poland there are only basic regulations that give just the minimum level of requirements then, in most cases, all residential buildings, social dwellings as well as luxury apartments, are of the same acoustic quality. The paper presents a proposal for acoustic classification scheme that gives clear assessment rules for the evaluation of dwelling quality. It is designed for architects, developers, local authorities but first and foremost for final users to provide them a tool which guarantee, that the quality they expect is well related to the price they pay.

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Examination of the Impact of Crosstalk in Linear Ultrasonic Arrays on the Generated Acoustic Field Distribution

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Various types of crosstalk can occur in ultrasonic linear arrays consisting of many elementary piezoelectric transducers. When a variable electrical voltage supplies one or

several transducers of such array, some of others transducers adjacent to the activated ones are excited to undesirable vibrations as a result of a crosstalk. This effect is caused by a penetration of electrical voltages between the set of mass and electrode leads of elementary transducers (electrical crosstalk) as well as by the superposition and the propagation of different modes of vibrations (longitudinal, transversal, surface and Lamba waves) in the array construction and in the medium adjacent to the array surface (mechanical crosstalk). The crosstalk is one of the main causes of distortions impairing the quality of ultrasonic images obtained, particularly in medical applications, because the crosstalk distorts the directivity pattern of the array and can also produce its impulse response disturbance.

In the paper, the impact of the crosstalk effect in a number of especially designed linear ultrasonic transducer arrays on the distribution of the generated acoustic field was examined and analyzed. It was demonstrated on the basis of measurement that the crosstalk introduces characteristic distortions of acoustic field distributions narrowing the directivity pattern and forming unwanted local maxima of the acoustic pressure in side parts of the pattern. Measurement results were confirmed using an designed innovative calculation method allows for the simulation of the acoustic field generated by multielement ultrasonic arrays. Results of the study also showed that the acoustic field distortions due to the crosstalk can be reduced by means of a proper selection of the material of the array front matching and protection layer, its thickness and method of application.

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Comparison of Different Methods of Assessing a Reliable Level of External Noise

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Polish standard PN-B-02151-3 defines a reliable level of external noise which is then used for selection of required sound insulation of façade. Recently updated version of the standard published in October 2015 redefined this document.

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The Risk of Hearing Loss among Music Students

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The amount of sound exposure and the risk of hearing loss resulting from everyday musical activity were assessed for music students at the Fryderyk Chopin Music University in Warsaw. The measurements of sound exposure and the assessments of NIPTS (Noise Induced Permanent Threshold Shift) risk were made according to the ISO 1999 standard. As expected, the results showed that, in many cases, especially for wind and percussion instruments, the exposure to sound exceeded the permissible limit of 85 dB (A). Assuming 45 years of similar exposure in terms of level and weekly duration it was predicted that 16.6% of men and 9.9% of women will acquire a hearing loss exceeding 25 dB. The highest risk of hearing loss occurs for flutists and French horn players (23% men and 15% women).

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Influece of Scattering Conditions of the Medium on the Value of the Effective Number of Scatters

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Quantitative assessment of the ultrasonic echoes may to be a complementation of the traditional ultrasonic diagnosis based on us b-mode. One of such technique is the analysis of the RF signals by modeling statistics of the signal envelope by using probability density function and determination of the shape parameters of it. The presented studies concern the evaluation the influence of the scattering properties of the medium on the value of the shape parameter of the k distribution, which is called the effective number of scatterers (ENS).

Experiments were performed on phantoms with various scatterers concentrations: 5, 8, 15 and 20 scatterers/resolution cell. The ultrasonic backscattered signals from the mimicking phantoms were acquired using a single-element 6Mhz transducer. Registered echoes were analyzed statistically in a goal of exploration of the relationships between the effective number of scatterers and the structure of scattering medium.

For the scattering medium with the lowest scatterers concentration (5 scatterers/resolution cell), the effective number of scatterers was equal 1.82 and increased to 14.18 for the phantom with the highest concentration (20scatterers/ resolution cell). Presented results demonstrate that the values of the effective number of scatterers depend on the properties of scattering medium and may provide additional information about it.

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The Influence of Signal Spectrum on Sound Source Distance Perception

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The aim of this study is to investigate the possibility of distance perception of the sound source by the human on the basis of the sound source limited to a certain range of frequencies. To minimize the influence of the environment, research has been done in anechoic environment. Due to the

fact that the eyes significantly improves the localization of sound sources also directly invisible sources, the persons participating in the study were blindfolded, so that the only sense used to the perceived distance was the sense of hearing. It has been found that it is possible to indicate the frequency bands which can be identified as a factor affecting the perception of the distance of the sound source.

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An Analysis of the Multi-Quadratic RBF in the Description of the Room Acoustics

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An efficiency of the MLM is analyzed in an acoustic indoor problem. The solution is assumed in the form of the series Hardy's multi-quadratic functions. The room acoustic field with practical combinations of the acoustic impedance boundary conditions, expressed via all absorption coefficient values, are considered. It is established any coefficient in the multi-quadratic functions depend on the number of influence points, the frequency and the absorption coefficient. All results are compared to the exact one. This way, it is proved that the MLM based on the multi-quadratic functions is useful in the description of the complicated acoustic boundary problems.

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Improvement of Methods for Underwater Targets Detection and Target Motion Tracking using Long-Range Sonar with Towed Linear Array

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The long-range passive sonars with long, linear, towed antennas are actually the best systems for detection and determining bearings to the modern, quiet and stealth submarines. Therefore they are used on large ASW ships and on large submarines, despite the hardships in immersing, towing and raising their antennas and despite the complexities and ambiguities of indications (the symmetric bearings to the targets only – without distinguishing between left and right side and the absence of direct indications of distance to targets). The paper briefly presents the methods of sonar operators proceedings (various filtration of the received signals imaging, target's "acoustic signature" application etc.) running, despite these drawbacks, to detect the target, attempts to classify it and even to track the target's movement (TMA – target motion analysis). The TMA procedures are presented broadly including graphical interpretations from the sonar's monitors. Described methods have been developed on the basis of the experience of the operators obtained, for several years, during the operation of sonars on Polish frigates.

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Application of Ultrasound Longitudinal Wave Velocity Measurements to Quality Assessment of Fibre Cement Boards

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Increasing production volume of fibre cement boards and their application as high-quality building facade material enforces the engineers to improve the methods of quality testing of this building material. A significant problem related to the fabrication of fibre cement boards is to prevent them from delamination during their forming of cement paste, water, cellulose fibers and lightweight aggregates. Several methods are in use to detect and assess the concentration and dimensions of defects after fabrication. Among them is non-contact testing applying the ultrasound Lamb waves and inspection of cores drilled from the produced material using X-ray microtomography. The novel method proposed employs a holder with two ultrasonic transducers and a portable defectoscope. A holder allows for firm and repetitive coupling of wave transmitter and receiver with tested object. Finally the results of longitudinal wave velocity measurements at 1 MHz frequency made in different specimens are presented.

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Pitch Strength of Residual Tones Estimated with the Method of Adjustment

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The study was carried out to clarify a discrepancy observed between the assessments of pitch strength based on identification of musical intervals (Houtsma nad Smurzynski, 1990) and on chroma recognition by absolute-pitch possessors (Rogowski and Rakowski, 2010). In the present experiment pitch strength was assessed with the method of adjustment. The group of subjects comprised 70 young musicians. The stimuli were harmonic complex tones with several lower partials removed, containing a number of successive overtones located in various parts of the harmonic series. The results indicate that the perception of virtual pitch is distorted by the overtones located at the tone's spectral edges and the interference effect of the spectral edge becomes more pronounced as the overtones are moved higher in the harmonic series. The data also demonstrate notable differences across subjects in the perception of virtual pitch.

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Detection and Recognition Thresholds of Environmental Sounds

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Recognition and detection thresholds were measured for 16 selected environmental sounds to determine the difference between those thresholds, called the recognition-detection gap, RDG. The experiment was conducted on two groups of listeners: 10 musicians and 10 non-musicians. The results show that RDG considerably varies depending on the sound: some sounds are recognized almost as soon as they are detected while other become recognizable only when the signal level is well above detection threshold. For most sounds no systematic difference in the size of RDG was found between the groups of musicians and non-musicians and the RDG differed only by less than 2 dB across groups. The results do not support a working hypothesis assuming that musical training results in better sound recognition abilities at near-threshold signal levels, when not all acoustic signatures of the sounds are clearly audible.

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Mechanical Properties and Instability of Pickering Droplets Probed by Electric Field Induced Stress and Ultrasonic Spectroscopy

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Recently, studies of particle laden droplets subjected to external electric fields has increased significantly with promising development in fields like electro-coalescence, destabilization of Pickering emulsions, or arrested coalescence. Here we study both the behaviour of microparticle stabilized droplets in electric fields and formation of Pickering droplets via electro-coalescence. Colloidal capsules (composed of jammed microparticles) are made on a surface of oil droplets. The investigation concerns the viscoelastic deformation, shell unjamming, and solid-to-liquid transition of monolayered shell, and dynamics of shell formation. A new unreported method of fabricating Pickering shells is demonstrated. We study the dynamics of formation of Pickering emulsion by indirect methods, e.g. ultrasonic spectroscopy, which may reveal the phase transition of the surface of a droplet (from liquid to solid like, when the droplet is fully covered by particles).

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Doppler Measurement of Acoustic Streaming

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Acoustic streaming is a steady flow in a fluid driven by the absorption of the ultrasonic wave. The aim of this work was to use the 20 MHz custom built 128 gates pulsed Doppler to measure streaming velocity generated by 1 MHz continuous wave ultrasound. The source of ultrasound was the flat piezoceramic transducer generating long pulses at 0.2 W/cm^2 acoustical intensity. Measured velocity profiles were compared to computer simulations and finally to the color flow images recorded by the Siemens Acuson Antares ultrasonic scanner operating in the color Doppler mode at 8.9 MHz.

The streaming was generated in a vessel simulating free space, repeated in a multi-well cell culture plate and in the limited space inside the 8 mm diameter silicone tube positioned perpendicular to ultrasonic beam. The maximum recorded streaming velocities were 3.2 cm/s, 6.1 cm/s and 0.3 cm/s respectively. The results obtained confirm the developing of the streaming phenomena was possible even very close to the source in the limited space. This effect will be explored in *in vitro* experiments of blood clots dissolution within the tube simulating a blood vessel.

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Experimental Verification of Adaptive Method for Plate Vibration Control

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The article present an adaptive control procedure based on online identification and pole placement method. The test object was circular plate with MFC actuators and velocity feedback signal. Sensor signal was collected with use of noncontact laser measurement method. This method allows fast reconfiguration of the position sensor and high precision of measurement. System model of the object was identified online with use of RLS algorithm which allow to identify unknown system, online as parametric model (e.g. ARX). This approach is an alternative to offline identification, where to calculate the object model is necessary to perform a separate experiments with series of analysis and optimizations. The use of recursive algorithm reduces the computational effort but the result is sensitive to the data perturbations (ill-posed problem). Control law was design by pole placement method and solving Diophantine equation. Designed adaptive controller was implemented and tested with use of xPC Target platform. The results of implementation and tests was presented in this paper and compared with simulations.

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Propagation of a Multimode Waves through Multi-Port Cylindrical Duct-Like Systems

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Over the years the problem of sound propagation in systems containing duct-like elements has been analysed by means of different methods, however most frequently restricting considerations to the plane wave, that is to low frequencies. However, in the last two decades more and more interest has been directed towards generalisation of these methods by going beyond the low frequency limit, that is to include also propagation of the higher modes. Between these methods the one, two, and multi-port technics have been substantially developed. In general, the N-port method ($N = 1, 2, 3, \ldots$) can be developed based on a number of different formulations dependent on the choice of two state variables at each duct-like joint of a system. The state variables could be chosen from the sound pressure p, the volume velocity q or the sound pressures p^+, p^- of waves travelling across a joint in both directions. The formalism in which the sound pressure p and the volume velocity q are chosen as state variables is called transfer matrix formalism, while choosing sound pressure as an output variable and the volume velocity as the input variable we come to the impedance matrix formalism. Selecting the state variables inversely we obtain the mobility/admittance formalism. The most flexible from all of the methods is the so-called scattering matrix formalism in which the input/output state variables are chosen from p^+, p^-. All of these formalisms mentioned above are equivalent, what means that there exists the unequivocal transformation from one to another. They also have some shortcuts, so it is important to choose the one which leads to the solution in a simplest possible way. In the paper the unequivocal transformations from one formalism to the other propagation are presented and applied to analyse the multimode waves propagating through cylindrical joints connecting "black boxes".

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Analysis of Resonator with Directional Converter of L-L Type

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From among the existing possibilities of creating various types of resonators with vibration directional conversion (i.e. L-L, L-L-L, R-L, L-R), the L-L type resonator is of greatest practical significance. In this case, the vibration analysis can be performed e.g. with the classical method, by solving movement equations for the particular resonator elements: the common part and the arms. Among others vibration analysis methods, the finite elements method (FEM) deserves special attention. The paper presents the L-L type converter vibration modes obtained with this method, as well as the resonance frequencies of the converter for particular vibration modes. The results of resonance frequencies calculations were compared with those of experimental studies; full consistency was observed between the frequency measurement results and the outcomes of the method analysis with the use of the ANSYS program.

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Speaker Recognition for Emotional Speech

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Speaker recognition encounter difficulties in dealing with changes in speaker' condition, like tiredness, an illness or emotional state which can influence speakers' voice features. The paper presents the results of speaker recognition tests carried out for emotional speech samples. The database of Polish emotional speech consists of recordings of six acted emotional states ("Big-six": anger, sadness, happiness, fear, disgust, surprise) plus the neutral one. The speaker recognition was carried out with standard features (Mel Frequency Cepstral Coefficients) and classifier (Gaussian Mixture Models). The obtained EER (Equal Error Rate) speaker verification scores depend on speakers' emotional state. The results were compared with subjective and objective emotion recognition results for the same database. The emotion influence for voice recognition is even more significant for emotion with strong activation factor.

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Glass Samples as Acoustic Birefringence References

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Various samples with artificial flaws found application in ultrasonic testing of materials. Some of them are used for education, some for calibration of ultrasonic equipment. In steel possibility of manufacturing of various reflectors are usually limited to simple geometries like cylinders, flat bottom holes, various grooves or notches. There are also limitations to produce small reflectors deep under the surface. All reflectors manufactured using machining present 100% reflectivity of ultrasonic waves. Alternative to steel samples with machined reflectors is optical glass and subsurface laser engraving. Velocities of longitudinal and shear ultrasonic waves in optical glass are almost the same as in carbon steel. Laser engraving allows to produce inside the glass block almost unlimited variety of reflector shapes, orientations and sizes. Single laser action produces a small, about 0.1 mm long, cracking. Such cracks, situated close to each other, can create various surfaces. Separated cracks

spread in the volume can modify acoustic properties of naturally isotropic glass and develop acoustic anisotropy, acoustic noise or locally increase attenuation of ultrasonic waves. Paper presents results of measurements performed on laser engraved samples imitating numerous micro-cracks as in steel subjected to creep, regions presenting high acoustic noise and on various artificial flaws reflecting ultrasonic waves.

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The Influence of Sound Source Rotating around the Listener on the EEG Morphology

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The purpose of this paper is to determine the effect of the sound source moving cyclically around a listener, to changes in the morphology of the EEG signal. The study was conducted on a group of 12 right-handed people (6 women and 6 men) in the auralization laboratory. Used, moving phantom sound source in a circle around the listener with a frequency of 13 Hz, in the horizontal plane, at the height of the listener's head. During the tests recorded EEG listener, which then was subjected to statistical analysis. Changes in the morphology of EEG signals were analyzed for the six frequency bands: delta, theta, alpha, smr, beta1 and beta2. Conducted qualitative and quantitative analyzes have shown the impact of moving sound source on the morphology of the EEG signal.

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Acousto-Optics and Its Perspectives

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In the development of science and technology there is a perceived general tendency or even a challenge to examine smaller and smaller objects and constructions in experimental studies and to apply them in practice. Studies of acousto-optical phenomena based on the light and ultrasonic waves interactions represent the domain where this tendency is very evident. In optical and ultrasonic spectroscopy as well as in acousto-optics it means application of the higher and higher frequencies of waves (the shorter and shorter wavelengths) to develop examination methods of matter structure and to improve construction of acousto-optical devices. In recent years it led to the possibility to cover experimentally the whole upper range of frequencies of elastic waves (ultrasonic ones to the terahertz frequencies of the order of several THz and the hypersonic ones in the range of 10–100 THz) and to interact them with the light. Recently, there have appeared some fields of acousto-optical studies in new materials of attractive properties pointing out to new perspectives for progress in acousto-optical interaction phenomena research and applications.

In the paper elements of the history and current interests in the field of acousto-optics are presented. Also, In a short literature review some examples of examination results on light and high frequency ultrasonics interactions in attractive materials and remarks about perspectives in research and applications are considered.

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Automatic Guided Analysis of Electrical Guitar Sound

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Electric guitar is a string instrument (chordophone). The sound obtained from a guitar is a result of a string vibration converted into changes of electric voltage by the electromagnetic converter (guitar pickup). The obtained sound from guitar play is dependant by many factors: used material; size and shape of the instrument; type of used strings and mostly by the mounted guitar pickups. One of the most important factors is the style of play used by the musician: position of the point and angle in which the force is applied to the string; inputted force value. The paper presents research on the influence of electromagnetic pickups used in electric guitars on the obtained sound from the instrument. For the elimination purpose of some factors that influence the sound produced by the electric guitar, an automatic guitar plucking test stand enabling to conduct a repeatable pluck in the set position was created. Article presents the result analysis obtained from the research on the sound produced by the electric guitar.

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Optimization of Natural Frequencies of Soundboard Viola da Gamba

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The article concerns optimization of a series of natural frequencies for the soundboard of the instrument Viola da Gamba. This approach preserves the specificity of the instrument timbre, the registration of the plate other dimensions, material properties and thickness. Additionally, in the case of using a material other than wood (spruce), e.g. elastomer, through the process of optimization, is it possible to adjust other parameters in order to preserve the properties of a musical instrument. Furtheremore, the work includes a multi-criteria optimization carried out three models of plates: analytical rectangular flat, rectangular flat numeric, and numeric soundboard of Viola da Gamba. In this case, the optimization process involves changing the input parameters (geometric dimensions, the thickness of the disc material parameters – spruce) in order to achieve the introduced objective function, which is to match the series of natural frequency models to experimentally measured vibration soundboard of full instrument Viola da Gamba. Tested models include orthotropic properties of wood, while the digital models plates were made using the finite element method (FEM). The study showed

that for flat rectangular plates (analytical and numerical), the established criteria related to the selection of parameters and dimensions of spruce boards, you can fit a maximum of 4 out of 11 natural frequencies. In the case of the model plate Viola da Gamba, this number increases to 9 frequency, assuming a maximum difference of 10% in both cases. It was determined as the validity of the parameters in relation to the frequency changes.

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Range of Hydroacoustic Devices in Different Hydrological Conditions

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Range of devices for underwater observation depends on the propagation of acoustic waves. The sound speed that is used to determine the distance between the hydroacoustic devices and a target object depends on the temperature, salinity and hydrostatic pressure. The biggest influence on the propagation of acoustic waves in the shallow water has a temperature changes. Temperature of the upper layer of water depends on weather conditions, mainly the air temperature. The deep layer waters in typical seas has a constant temperature, a factor for the sound speed is the hydrostatic pressure. Depending on the reservoir layer boundaries are at different depths. The differences in the speed of propagation influence the shape of the tracks of acoustic radiation, which affects the range of devices. This phenomenon associated with changes in the sound speed in water, known as refraction, causes deflection of the sound rays, which contributes to increasing the errors in determination of target coordinates. This paper presents a conditions for sound propagation in the Southern Baltic Sea and the impact of the phenomenon of refraction on range of hydroacoustic devices.

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Acoustic Emission Testing of LPG 2700 Tanks

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In the paper results of analysis of the properties of signals recorded using acoustic emission method during the test of standard LPG 2700 tank are presented. The signals were recorded with 32-channels measuring system Vallen AMSY-6 with sensors ISAS3-150 while generating signals coming from modeled sources by Hsu-Nielsen method and during the two cycles of pressure changes in the test object. For modeled sources analysis includes multiple locations performed using different configurations of sensors. Obtained results were analyzed in terms of selection of the minimum number of sensors ensure the networks required for location of sources. An analysis of signals aiming to minimizing number of sensors, in the case when location of sources is not required and the purpose of research is the answer whether the activity of acoustic emission in the test object is increased, ware carried out. The results of analysis of signals recorded in two cycles of pressure changes shows identification of disturbances and elimination of signals coming from these disturbances, location of active sources during test (sources of class C and source class "not classified") and a description of properties of the signals from these sources.

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Influence of Transmission-Reception Characteristics of Ultrasound Transducers on Statistics of Echoes from Nonhomogeneous Media

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The statistical parameters of the envelope of echoes can be used for quantitative classification of normal and pathological tissues. Such approach is very sensitive on various subjective parameters not connected with the internal structure of measured medium, e.g. on measured setup. Here we show the theoretical analysis of the influence of the size of transducers on statistics of ultrasound echoes.

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Vibration Analysis of a Washing Machine Casing for Active Control Purposes

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The active casing approach is a technique to reduce noise emission of devices and machinery by controlling vibrations of their casings. Sound insulation efficiency with this technique has been confirmed by the authors in previous publications for several laboratory casings. In this paper, a real device casing is considered, which is a market-available and unmodified product – a washing machine. To prepare an active control system application, firstly a vibration analysis of the device casing needs to be performed. Initially, the casing walls are acoustically excited to measure its natural vibration frequencies and mode shapes. Subsequently, the casing vibrations are measured during regular device operations. The measurements are performed with a laser vibrometer. Obtained results are reported, discussed, and conclusions for future research are drawn. The research reported in this paper has been financed from the state budget for science, and by the National Science Centre, Poland, decision no. DEC-2012/07/B/ST7/01408.

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Usefulness Analysis of the Selected Acoustical Parameters for Classifying Highly Impulsive Sounds

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Arbitrary classification of impulsive noise is based largely on subjective assessment. While for measurements performed close to the sound source, classification of these signals raises no difficulties, the evaluation in the far distance becomes problematic. In the latest draft standard ISO 1996 there is still no specified objective measurable parameters dedicated to differentiate impulses. These parameters are especially important in assessment of the signals in the far distance from the sound source, where impulsive character is vanishing or it is masked by ambient noise. The paper presents the results of research on highly impulsive noise with a proposal for measurable parameters to classify acoustic impulses. That classification is essential for applying appropriate value of impulsive adjustment, which now is strictly set to 0 or 12 dB.

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Analysis of Usefulness of Selected Models to Railway Noise Predictions in National Condition

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One of the most important sources of railway noise is the rolling noise – resulting from the interac-tion between vehicle and track and the aerodynamic noise. The movement of the train excites the vibra-tion of the carriage, especially in side surfaces of the wheels – then the rolling noise is formed. Sound pressure level of rolling noise is strongly relative to the conditions of wheels and track. Other relevant sources of railway noise are traction noise (at low speeds), aerodynamic noise (at speeds above 250 km/h), braking noise, squel noise on track curves or noise which is created when train passing by the crossovers. These factors are dependent on the type and condition of railway, type of brake, speed of train and position of the track. Depends on the computational models of railway noise, indicated factors are considered in different ways, some of it are neglected. In Poland, the most common used model of railway noise is the Dutch model RMR. Recently in Commission Directive (EU) is described another railway noise model. Therefore, in the paper have been characterized main principles of the newest calculation method compared with other known models. In the experimental part of the work, there have been conducted series of measurements on the railway sections with varying track condition. The results of measurements were the basis for verification and indication the advantages and disadvantages of the algorithms in modelling railway noise in Polish conditions.

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Evaluation of the Usefulness Vibroacoustic Parameters in Speech Defects Analysis

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Stuttering is a disorder of fluency, occurring in both children and adults. It prevents free and smooth transition from one articulation to another, and to maintain an appropriate pace, rhythm and intonation of speech. In natural speech important is the intention of the transmission of information, which determines the rate of speaking and prosody used in a targeted manner. Pathological stuttering is accompanied by physiological symptoms, often combined with co-movements of the body, face, hyperactivity and spasticity. Emotionally it affects communication and social language. Inability to speak liquid leads to tension and stress of speaking. In problems of medical diagnosis, including planning and monitoring the therapy and rehabilitation of voice organs or speech-related organs, it is necessary to evaluate the qualitative features of the acoustic signal of deformed speech. One of the methods of testing which gives opportunities for a proper evaluation of the vocal folds in the process of stuttering, and the diagnosis of these disorders and for monitoring the progress of both, as well as the final effects of stuttering therapy is electroglottographic methods and acoustic spectral analysis of speech. In this paper we present the results of the speech signal stutterers. On the basis of these results, we developed a method of identifying types of stuttering.

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Propagation and Absorption of Acoustic Waves in Open-Porosity Media

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Propagation and absorption of acoustic waves in open-porosity media with rigid frame can be very effectively predicted using models which substitute an investigated porous medium with an effective dispersive acoustic fluid in order to apply the Helmholtz equation. Among many existing models of that kind, the advanced semi-phenomenological theory by Johnson, Allard *el al.* is the most versatile, because it considers directly both viscous and thermal effects; therefore, it also forms a background for modelling of acoustic wave propagation in poro-elastic media where the adapted Biot's theory is applied. The Johnson-Allard-et al. models use at least 6 macroscopic transport parameters: the porosity, the tortuosity, the permeability and its thermal analogue, and two characteristic lengths – for viscous and thermal effects. Most of these parameters can be directly measured, however, miscellaneous experimental equipment is required for this purpose. The transport parameters can also be calculated

from porous microstructure provided that a representative micro-geometry is known for the investigated medium. The so-called multi-scale modelling of sound absorption and propagation in porous media is based on this fact. The transport parameters are determined from finite element analyses carried out on representative cells constructed for porous, fibrous or granular microstructure. Then, these parameters are used by the Johnson-Allard-et al. formulas in order to compute some harmonic material characteristics, which serve to determine the complex and frequency-dependent effective speed of sound and effective density of the medium. Thereby, among other things, the acoustic impedance and absorption coefficient can be calculated for a layer of the investigated medium with a specified thickness. The multi-scale modelling is therefore validated with experimental tests, where the sound absorption is measured for a sample of open-porosity foam, for a layer of fibrous material made up of a copper wire, and for a granular layer formed from loosely packed rigid beads.

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The Use of Genetics-Based Methods in Synthesis and Analysis of Aquatic Animals' Sounds

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The paper aims to present a novel genetics-based method of analysis and synthesis of acoustic signals for communicating with aquatic animals. The method is envisaged to solve the problems encountered by the current solutions, namely their incapacity for adaptation to external conditions and for taking into account the animals' capability of learning. A method based on natural mechanisms of genetic expression and pattern emergence shows promise in this task, as it allows for a structured, yet non-repetitive expression as required. Modern understanding of molecular genetics, and especially the capacity of the genome for directed change and for flexible, sophisticated control of the cell's operation, is conducive to the task, as it enables us to both design complex yet responsive non-repetitive expression control systems, and to evolve them in a directed, controlled way.

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A Concept of a Numerical Simulation of Sound Generation in Blown Idiophones

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Blown idiophones are musical instruments in which a thin bar with its own stiffness serves as the vibrator and a stream of air as the actuator. The resonator can take various forms. This category contains among others: the accordion, the harmonium, the harmonica and reed organ pipes. Because of the highly complicated process of sound generation in these instruments, attempts to develop an analytical description despite numerous simplifications lead to very complex models. Difficulties are faced also in measurements. In the article a concept of a numerical simulation of the process of sound generation in blown idiophones is presented. It should enable receiving and visualising the data hard to obtain through measurements or by an analytical approach, upon which the final sound of the instrument depends. The described concept deals with the coupled problem of: a flow in fluid, a displacement of solid and a propagation of acoustic wave. A C++ toolbox called OpenFOAM was chosen for solving the governing equations. Discretization is made according to Finite Volume Method.

Results of a test simulation were featured. It was carried out according to the proposed concept with numerous simplifications. Conclutions would be guidelines for further work on the issue.

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