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Chronicle

50th Jubilee Winter School on Wave and Quantum Acoustics XLIXth Winter School on Environmental Acoustics and Vibroacoustics Szczyrk, Poland, 28 February – 3/4 March, 2022

On behalf of Upper Silesian Division of the Polish Acoustical Society (main organizer) and Committee of Acoustics of the Polish Academy of Sciences (coorganizers) we are pleased to announce that according to many years of tradition the above-mentioned Conferences known as "Winter Schools" have been organized and carried out.

50th Jubilee Winter School on Wave and Quantum Acoustics constituted platforms for sharing the results and achievements obtained in different branches of physical acoustics (e.g. molecular acoustics, relaxation processes, quantum acoustics, acousto-optics, magnetoacoustics, photoacoustics, acoustics of solid state, acoustic emission etc.). Conference consisted of 17th Workshop on Acoustoelectronics and 17th Workshop on Molecular Acoustics, Relaxation and Calorimetric Methods.

XLVIXth Winter School on Environmental Acoustics and Vibroacoustics was the forum for all environmental and vibroacoustics fields. Particularly it concerned traffic noise, vibroacoustics of machines, room acoustics, building acoustics, noise protection and similar problems.

Celebrations of the "Golden Jubilee included:

- Jubilee Session with plenary lecture "The Golden Jubilee of the 50th Winter School on Wave and Quantum Acoustics – historical reminiscences" presented by prof. Tadeusz Pustelny and numerous touching addresses,
- Special Session "50 years have gone by... – an evening of remembrance" conducted by prof. Marzena Dzida; it was a very nice session, without time restrictions as to presentations and discussions and the real duration of this session was twice as large as planned.

Finally, 52 people participated within Conferences presenting 44 lectures, reports and posters. In this issue one can find abstracts of some lectures and posters, which were presented during the Conferences.

We are pleased to announce that on 27 February – 2/3 March, 2023, we will organize the next "Winter Schools" containing the Lth Jubilee Winter School on Environmental Acoustics and Vibroacoustics and 51st Winter School on Wave and Quantum Acoustics. Thus, just now we invite you to participate in this "Golden Jubilee" Conference.

We would like to invite scientific centres and groups to cooperate in organizing workshops on the subjects of their interests related to the theme of the Conference.

Further information about Conferences is available on our website

https://ogpta.pl/index.php/en/

On behalf of Organizers
Franciszek Witos

Abstracts

Application of artificial intelligence methods to signal enhancement for predictive maintenance of rotating element bearings

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Every rotating machine consists of rotating element bearings and when a fault occurs in these rotating elements bearing due to any reason, the whole machine suffers. When a sudden shut down take place in industrial or military machines, it costs financial as well as personal damages. Therefore, these sort of sudden shut down of rotating machines are avoided by means of predictive maintenance using different signal processing techniques. Vibration signals acquired from the faulty bearings are analyzed to find out the fault frequency spectrum and then fault source. But when the noise to signal ratio is high, the traditional signal processing techniques such as kurtosis or spectral kurtosis – are not capable to find out the fault frequency spectrum. In this research work, we proposed a band-pass filter that filter out the background noise and helps to find out the fault frequency spectrum. The fault frequency can occur in any bandwidth and therefore, it is challenging to find out the precise bandwidth and center frequency of the band-pass

filter. Failure to find the precise band-pass filter can lead to serious damage in rotating machines. To solve this serious issue, Harmony Search (HS) Algorithm is used to estimate the precise band-pass filter. In the proposed method, we use two fitness functions: kurtosis and spectral kurtosis. To validate the performance of the proposed method, different vibration signals were tested including early-stage roller element fault signal, early-stage outer race fault signal, and outer race fault signal with different loads. From the simulation study, it was concluded that the performance of the spectral kurtosis is better than the kurtosis as a fitness function to distinguish the healthy and faulty bearing. The results were further compared with the traditional way of designing band-pass filter using kurtogram and it was concluded that band-pass filter designed using the HS algorithm with spectral kurtosis as a fitness function performs better than the band-pass filter designed using kurtogram.

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Magneto-responsive microcapsules fabricated from pickering droplets

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In an upcoming era of individual approach to the therapies of common diseases, particularly cancers, there is a severe need to find solutions that allow for safe and precise delivery and release of pharmaceuticals in the site of interest inside the patient body. One of the possible approaches is the preparation of small capsules that serve as cargo agents. The external stimuli such as gradient magnetic field can non-invasively provide them into the specific location. Recently, we prepared such capsules responsive to external magnetic fields from droplets covered by particles (so-called Pickering droplets) via sintering in an alternating magnetic field.

During the presentation, the method of formation of colloidal capsules from Pickering droplets as precursors using ultrasonic, electric, and magnetic fields will be introduced. We will also show the responsiveness to the external low-gradient static magnetic field. The important issue remains also the proper characterization of capsules when prepared in bulk quantities. Therefore, we will also provide some ideas of the further experiments using capsules and ultrasound analogically to contrast-enhanced agents in ultrasound scanning (ultrasonography).

The work was supported by the Polish National Science Center by the grant 2019/35/N/ST5/00402.

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Noninvasive ultrasounds Doppler effect based method of liquid flow velocity estimation in pipe

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The article discusses the estimation of the flow velocity from a calmed on multi-sensor. Several different estimation methods of real Doppler shift in a noisy environment are used and based on it calculate flow velocity in the pipe. For the collected estimates decision level information fusion is proposed to establish flow velocity with high precision and low variations. Simulation results for plastic and steel pipes demonstrate the possibility of accurate liquid flow measurements without installing sensors inside the pipe.

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Multi-walled carbon nanotubes influence on isobaric heat capacity of ionanofluids

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Ionanofluids (INFs) – ionic liquids (ILs) containing dispersed within multi-walled carbon nanotubes (MWCNTs) possess excellent thermal conductivity, whereas effect on isobaric heat capacity (C_p) has to be settled yet due to contradictory results presented in the literature. The INFs composed of 1-ethyl-3-methylimidazolium thiocynate [EMIm][SCN], 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide [BMPyr][NTf_2], 1-propyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide [PMPyr][NTf_2], 1-hexyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide [HMIm][NTf_2] or 1-ethyl-3-methylimidazolium ethyl sulphate [EMIm][$EtSO_4$] and several types of multi-walled carbon nanotubes (MWCNTs), including functionalized MWCNTs, were investigated.

In general, non-functionalized MWCNTs did not alter C_p of investigated INFs. Promising results were observed for INFs composed of MWCNTs functionalized with polar groups, i.e. the obtained C_p enhancement of 3.2% was achieved for [EMIm][SCN] + 0.50 wt% MWCNTs-COOH at 323 K.

This work was financially supported by the National Science Centre (Poland) Grant No. 2017/27/B/ST4/02748.

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Thermal conductivity of 1-alkyl-3-methylimidazolium bis(trifluoromethylsulphonyl)imide-based nanofluids

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We examined the effect of alkyl chain length in cation of the ionic liquid on the thermal conductivity of ionanofluids (INFs) at 25°C. We studied four series of INFs in concentrations from 0.25wt% to 5wt% of multi-walled carbon nanotubes (MWCNTs) based on 1-alkyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imides with 2, 4, 6 or 8 carbon groups, i.e. [EMIm][NTF_2], [BMIm][NTf_2], [HMIm][NTf_2] and [OMIm][NTf_2], respectively.

Unremarkable thermal conductivity enhancement of 585%, 424%, 410%, and 442% with addition of 5wt% of MWCNTs to respectively [EMIm][NTF_2], [BMIm][NTf_2], [HMIm][NTf_2] and [OMIm][NTf_2] has been observed. The conductivity increase shows nonlinear dependence on concentration of MWCNT, characteristic for each series of INFs.

This work was financially supported by the National Science Centre (Poland) Grant No. 2017/27/B/ST4/02748.

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Minimizing the effect of glottal flow on the scatter of HFCC coefficient values to increase the quality of speech signal frames classification

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The voiced parts of the speech signal are shaped by: glottal excitation, vocal tract, and the speaker's lips. The semantic information contained in speech is mainly shaped by the vocal tract. However, the periodicity of the glottal excitation, is one of the factors affecting the significant scatter of HFCC coefficient values, by introducing spectral ripples.

This paper proposes a method to reduce the effect of glottal flow excitation by correcting the amplitude spectrum of the voiced frames of the speech signal. The estimators of the correction functions were determined using inverse filtering (IAIF). Then, using HFCC parameters, statistical models of individual phonemes of Polish speech were developed in the form of a mixture of Gaussian distributions (GMM). The purpose of the amplitude spectrum correction was to narrow and spread the GMM distributions, which, according to the detection theory, reduces classification errors. The results confirm the effectiveness of the proposed method.

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Physicochemical properties of 2-methyltetrahydrofuran and tetrahydrofurfuryl alcohol as components of second generation biofuels

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The 2-methyltetrahydrofuran (2-MTF) and furfuryl alcohol (FA) are considered as attractive fuel bioadditives. The aim of this work is to study of physicochemical properties of 2-MTF and FA as fuel additives. The speed of sound in 2-MTF and FA was measured in the temperature range from 293.15 to 323.15 K using measuring set based on the pulse-echo-overlap method. Additionally, the speed of sound and density were measured in the temperature range from 278.15 to 333.15 K and 278.15 to 363.15 K for 2-MTF and FA respectively using Anton Paar DSA 5000M and vibrating tube densimeter Anton Paar DMA 5000M apparatus. The viscosity was measured at 288.15 K and 313.15 K using Ubbelohde viscometer. The flash-point was measured using Marcusson method. The physicochemical properties of 2-MTF and FA were compared with those of bioalcohols, heptane, dodecane and biodiesel. The density, viscosity, and flash-point were compared with norm EN 590 for diesel and EN 14214 for biodiesel. The physicochemical properties of 2-MTF and FA confirmed their potential as fuel bioadditives.

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Retrospective outline of the electroacoustic system in the national museum "Panorama Racławicka" in Wrocław (1985–2020)

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"The Panorama of the Battle of Racławice", a monumental masterpiece by Jan Styka and Wojciech Kossak – a work of national culture of great historical value, required both an appropriate facility and technical equipment. This paper presents a designed and produced electroacoustic system assisting the tour of an exhibition intended for a great numbers of visitors. A structure, principle of operation and basic technical equipment of sound system are presented. The main idea of applied system has proved itself in practice during 35 years of operation, but lots of equipment parts were changed due to new technical possibilities.

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Numerical analysis of the non steady state in response and recovery stage of a new SAW structure with RR-P3HT in detection DMMP

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The paper presents the results of numerical analyses of the SAW gas sensor in the non-steady state. The effect

of SAW velocity changes vs. the surface electrical conductivity of the sensing layer is predicted. The conductivity of the roughness sensing layer above the piezoelectric waveguide depends on the profile of the diffused gas molecule concentration inside the layer.

Numerical results for the gas DMMP (CAS Number 756-79-6) for layer (RR)-P3HT in the non-steady state have been shown (recovery and response step). The main aim of the investigations was to study thin film interaction with target gases in the SAW sensor configuration based on diffusion equation for polymers. Numerical results for profile concentration in non-steady state for concentration, thickness, roughnes and temperature have been shown.

The results of numerical analyzes allow to select the sensor design conditions, including the morphology of the sensor layer, its thickness, operating temperature and layer type (in steady state). The numerical results basing on the code written in Python, are described and analyzed. The theoretical results were verified and confirmed for profile concentration gas numerically.

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Characterization of magnetic and non-magnetic nanoparticles in oil suspensions by ultrasound spectroscopy

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Magnetic nanoparticles have been used in various fields such as biotechnology, material science, and engineering. Additionally, the nanoparticles can be used as stabilizers for the emulsion droplets and create magnetic Pickering emulsion. The use of magnetic nanoparticles causes the modulation of emulsion properties in response to external stimulus – magnetic field. The knowledge of particles properties, especially size, as well as their behaviour in suspension is an important issue in the preparation of Pickering emulsions.

In this research, the size of magnetic and non-magnetic nanoparticles were characterized by using ultrasound spectroscopy. The analysis of ultrasonic waves in a function of frequency provided information about the particle size. The experimental results of ultrasound attenuation were analyzed within the framework of the ECAH theory which takes into account contributions to acoustical parameters due to friction and heat exchange between particles and the surrounding carrier liquid and the scattering mechanism.

This work was supported by the Polish National Science Centre grant 2019/35/O/ST3/00503.

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Mercury vapour saw sensor with enhanced sensitivity

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The new kind SAW sensor for mercury vapour detection is presented in the work. The increase of sensitivity was achieved by exploiting both mechanical and electrical phenomena on piezoelectric surface.

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The simulation analysis of selected pulse waveforms in application to echolocation systems

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Sonar systems are divided into active and passive. In passive sonars, main tasks are detection and classification. In active sonars, it is particularly important to ensure adequate coverage and resolution. In addition, the active sonar system should provide adequate Doppler resolution, which is an important parameter necessary to track moving objects/targets. For both types of sonar systems, an important problem is the selection of the appropriate waveform that will ensure the required level of detection and the ability to determine the parameters of the received echoes in interference and noise conditions. Previously used CW (continuous wave) pulses require an increase in pulse duration and/or pulse amplitude to ensure the acceptable range, resolution and detection level in the presence of noise. This resulted in the need for compression techniques that provide a shorter pulse duration and an increase in pulse amplitude at the output of the filter matched to the transmitted signal. Commonly used LFM (linear frequency modulation) pulses provide very good distance resolution, but Doppler performance is not sufficient. Therefore, in sonar applications, the use of other waveforms such as pulses with phase coding (e.g. Barker or Frank codes), frequency hopped trains of pulses (such as Costas codes), pulses with polyphase modulation (e.g. P4 waveform) or even hybrid waveforms are considered

This research work was conducted with using the ambiguity function (AF) and cross-ambiguity function (CAF), which are excellent tools for determining the characteristics of selected waveforms and their usefulness in echolocation applications. The analysis was carried out taking into account the possibility of signal detection in noise and interference conditions and resolution abilities at distance and Doppler frequency.

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Magnets for magnetic drug targeting

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This contribution presents development of special magnets for magnetic drug targeting into brain of mousses and/or human in frame of EURONANOMED III project MAGBBRIS (cofund Horizon 2020)[1]. This project was devoted to demonstration that growth factors secreted by endothelial progenitor cells, having proven potential to induce tissue repair, can be encapsulated in magnetic biomaterials and successfully and safely transplanted into mice brains, with the guidance of magnetic fields, to induce tissue repair. The main role of our team was to prepare suitable magnetic systems for magnetic drug delivery to desired pathological region. We developed special magnetic systems based on the idea of focusing of magnetic field, magnets for mice and human experiments were constructed and first results with successful delivery are given in following reference bellow. The magnets for human applications were successfully demonstrated on artificial human head too.

[1] Grayston A. *et al.* (2022), Endovascular administration of magnetized nanocarriers targeting brain delivery after stroke, *Journal of Cerebral Blood Flow and Metabolism*, **42**(2): 237–252, Epub: July 6, 2021, doi: 10.1177/0271678X211028816.

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Analysis of the noise impact of VAWT wind turbines registered in a public building

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Noise and vibration are factors that can potentially affect the comfort of people working and living in buildings. Possible internal sources of noise in buildings are its equipment and technical installations. The source of noise can also be a installations and external devices that are integrated with the building or mounted on it. An example of such an external source could be a wind turbine, installed on the roof of a building or integrated with it (built-in). This issue is poorly explored and was undertaken by the authors for recognition.

As part of the research work undertaken, noise measurements were carried out in the range of low acoustic frequencies and infrasound, emitted by operating wind turbines with a vertical axis of rotation (VAWT). The registration was made in the building of the Opole University of Technology which has three VAWT turbines installed on the roof. Noise measurements were carried out in various weather conditions. The aim of the research was to analyze the level of low-frequency and infrasound noise, which could potentially affect inside the building.

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Application of piezoelectric structures for gas density testing

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The undertaken research topic concerns to the multivariate analysis of piezoelectric structures depending on the environmental conditions in which they operate. The aim of the preliminary research work was to investigate the possibility of using piezoelectric structures to determine the gas density based on the resonance frequencies of the components used. Two structures with different frequencies were analyzed and tested in gases such as air, helium and CO_2 for different meteorological conditions. The obtained results indicate some possibilities and reveal limitations of the adopted resonance frequencies. The issue requires further recognition on a wider range of resonant frequencies and under various operating conditions of piezoelectric structures.

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Characterization of acoustic emission signals generated by partial discharges under DC stress

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This paper presents results and analysis of acoustic emission (AE) signals generated by partial discharges (PD) in oil under DC voltage. The primal objective of this study is to describe fundamental characteristics of the PD under DC in order to propose adequate features that can be extracted from signals in order to further classification of different types of PD sources. Moreover, this paper compares AE signals emitted by several types of PD sources and analyzes influence of voltage level and polarization on these signals. Results show that different types of PD sources are characterized by unique characteristics, voltage influence is not crucial regarding this characteristics while voltage polarization confirms much more significant affection. This results can be used to support the diagnostic process of electric power apparatus in DC systems, especially regarding the correct interpretation of PD signals and their relation to the experience acquired in AC systems.

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Application of vibroacoustic in diagnostics of power transformers – case study

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This paper presents results and analysis of diagnostics tests on power transformers performed under on site conditions using vibroacoustic (VA) method. The primal objective of this study is to propose the optimal methodology for technical condition assessment of power transformers using VA supported by dissolved gas analysis (DGA)

method. Moreover, this paper analyzes the influence of disturbances generated by transformer cooling system on results achieved. This case study investigates two transformers: one with probable core defect and the other with no defects. Two sets of measurements recorded one year apart on these units are used in the study to illustrate the development of the potential defect. Results show that cooling system hardly affects the VA results, and relative rather than absolute changes of the measuring signals are essential from the diagnostic point of view. Experience presented in this paper may be used to support the diagnostic process of power transformers, especially regarding the routine tests conducted under normal exploitation conditions.

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Numerical study of an acoustic labyrinth metamaterial

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Limiting exposure to noise among employees of industrial plants remains one of the greatest needs and priorities in shaping the working environment in Poland. One of the possibilities that has the potential to solve the problem of exposure to noise are noise reduction systems in the form of the so-called acoustic metamaterials. Acoustic metamaterials are artificially produced materials which, thanks to an appropriate internal structure, have unusual acoustic properties. They allow to obtain significant values of sound attenuation or change the direction of its radiation, in particular for narrowband noise. The properties of acoustic metamaterials are strongly defined by their structure. Due to this fact, the production of an acoustic metamaterial must be preceded by appropriate numerical tests. The paper presents the results of numerical tests of the acoustic properties of a labyrinth structure. Simcenter 3D software and the finite element method were used for the calculations. The results of numerical tests were presented in the form of distributions of the sound pressure level for given excitations.

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Sound masking in the open space office rooms – evaluation criteria for sound uniformity, masking sources

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The article describes the results of calculation research using the ODEON software, three aspects related to the sound masking exposition an open space office room. The minimum (30 dB) and maximum (37 dB) A-weighted SPL (A-SPL) of masking sounds are specified. Two parameters were determined that characterize uniformity of A-SPL of masking sounds in the room. They are: the maximum permissible A-SPL difference (7 dB) and the permissible standard deviation of the A-SPL of the masking sound in the room (1.5 dB). Research has shown that the minimum number of masking sound sources/loudspeakers in the open space office room is 8–9 (room volume 210 m^3) and 12 (415 m^3). Out of the three layouts of masking sound sources, the loudspeakers in two lines, 4 each, provide the greatest uniformity of masking sound in the room (5.7 dB). Instead of using 8–9 or 12 loudspeakers. The same uniformity of masking sound was achieved by using four pyramid-shaped columns, each with four loudspeakers. The spectrum of the sound power level of the masking loudspeakers was determined.

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The impact of background noise on the distraction distance in open plan offices

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One of the factors making work difficult for employees in open space offices are the sounds of understandable employee conversations. However, the sounds of incomprehensible conversations (conversation buzz) and other sounds (e.g. from the technical equipment of the building), masking the former, have a positive effect on work comfort. The parameter for assessing the acoustic operating conditions in the rooms under consideration takes into account the acoustic properties of the room and the background noise masking the sounds of conversations. It is the distraction distance. In the article, on the example of a typical room, the results of computational analysis are given, the effect of A-weighted sound pressure level of background noise with two types of acoustic spectrum on the distraction distance are given. The first acoustic spectrum is typical for a background noise without the presence of people. The second acoustic spectrum is the resultant of a spectrum typical for a background noise without the presence of people and speech spectrum according to PN EN ISO 3382-3.

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Development of the SAFE website in the context of changes in the Polish labor market on the example of noise hazards

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The SAFER website developed at CIOP-PIB is a rich source of knowledge about harmful physical factors of the work environment. This website consist of content related materials, educational materials and small internet tolls aimed at supporting the assessment of exposure and occupational risk, for each of the factors described on the website. To maintain high usability, the website must be constantly updated and expanded with new knowledge. The article discusses the content of the website and presents its current development on the example of the section devoted to noise in the work environment. The discussed

development of the website takes into account changes on the Polish labour market related in particular to economic immigration.

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Total sound insulation of lightweight external frame walls with windows

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The acoustic effect of windows installed in a lightweight frame façade equipped with additional thermal insulation was considered. The research aimed to investigate the contribution of the façade main components to the total sound transmission loss. The frequency dependent sound insulation characteristic of a window is usually different than this of the opaque elements. Besides, the window inserted into the lightweight wall modifies the constructional scheme of the basic structure. The principal research question was about the accuracy of estimations of acoustic performance of the lightweight façade form performance of its elements. The study is based on laboratory measurements. Initially, two full-scale models of walls and three windows were tested separately. Then six variants of the façade consisting of different combinations of these elements were examined. The results of measurements were juxtaposed and compared with calculated values. Frequency dependent characteristics and single number quantities were considered. Despite different shape of the sound insulation plots of the façade elements the results of computations based on single number values and direct measurements seem consistent.

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Analysis of the possibility of using coded pulses in ultrasound tomography

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In conventional ultrasound imaging, significant improvement in the detection of pathological changes in tissue can be achieved by increasing the S/N ratio of received ultrasound echoes using ultrasound coded transmission by means of signals with linear frequency modulation (chirp) and discrete phase modulation with algebraic codes (Barker codes, Golay codes). In all such solutions, echoes are correlated with the standard transmission signal and then averaged. In this way, a large amplitude of the sounding signals is not required because the gain in the S/N ratio results from the compression of the recorded echoes. Coded signals can also be attempted to improve image quality in ultrasound transmission (UTT) and reflection tomography (URT). For this purpose, additional examinations are necessary due to the side lobes of the signals obtained from the emission of coded pulses, a multitude of pulse transitions, and image reconstruction algorithms. In this work, research using coded signals in the UTT and URT method was carried out on the ultrasound tomography scanner developed by DRAMIŃSKI S.A. in cooperation with scientists from Wroclaw University of Science and Technology.

The research was carried out under the project POIR.01.01.01-00-1595/15, entitled: "Development of a prototype of multimodal ultrasound tomography for breast diagnosis".

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A laboratory stand for wind turbine noise reproduction

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The development of wind energy is accompanied by numerous questions and doubts about the influence of wind farms on the human. Among the factors related to the operation of wind farms, wind turbine noise has to be seen as a source of annoyance for both people living and working near wind farms. Therefore, a test bench to reproduce different types of wind turbine noise in laboratory conditions have been developed. The test bench is based on a multichannel sound reproducing system using the DANTE network (in which digital acoustic signals are broadcast over Ethernet) and is compiled in the acoustic test chamber. The test bench consists of nineteen speakers, including sixteen Avantone MixCube studio monitors, two LS600 woofers and one laboratory infrasound source. The test bench enables to conduct wind turbine noise annoyance tests in laboratory conditions. The paper describes the elaborated test bench for wind turbine noise reproduction.

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Ultrasonic haptic technique – operation, expected applications and assessment of the risk of ultrasonic noise

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The ultrasonic haptic technique is a novel technique, that invokes a feeling of touch on human skin using a focused, modulated ultrasound beam. This technique is gaining more and more interest from both scientific and business worlds alike, giving hope for new possibilities of interaction with the work environment, especially concerning people with disabilities. Since the generated works using a modulated, high sound pressure level in a specific area of the space to achieve a feeling of touch, this technique is a potential source of ultrasonic noise harmful to humans, which needs to be thoroughly tested. The paper discusses the most important issues with the ultrasonic haptic technique as well as the current solutions in the field of ultrasonic haptic transducers and their expected practical applications. The results of preliminary research on ultrasonic

noise generated by haptic transducers available on the market and the assessment of the risk of this noise for the person using the transducer are also presented.

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Correction of errors occurring during the detection of pulse arrival time in ultrasound tomography

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An ultrasound tomograph is a device that can be used to visualize the internal structure of the breast. One of the obtained diagnostic images presents the distribution of local sound speed values in the breast cross-section. To reconstruct this image, it is necessary to know the time of transition of the ultrasonic wave through the tissue. The paper presents problems that occur when determining the arrival time with the use of the constant fractionation method and detection of the zero crossing. The procedure of eliminating errors appearing in this situation was also presented. An analysis of the speed sinogram is used during error correction. The value of the speed in the examined point of the sinogram is compared to the values in the neighbouring points. It is possible to detect large errors and more frequent shifts only by one or two periods of the measuring impulse.

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Magnetically responsive (nano)textile: preparation and application

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Currently there is an increased interest in the study of smart multi-functional (nano)textiles that are sensitive to environmental changes and respond to external fields; such (nano)textile can be used for a large number of potential technological applications. Of particular interest is the use of magnetic particles in combination with (nano)textile materials. Different types of magnetic nano- and micromaterials including magnetite, maghemite or ferrite particles can be used for (nano)textile modification. Magnetically responsive (nano)textile can be efficiently used for potential medical applications (magnetic hyperthermia for the treatment of cancer cells, scaffolds for the proliferation of osteoblasts, drug delivery, magnetic resonance visualization of surgical textile implants or biosensing), biotechnology (prevention of fungal biofilms development, antibacterial properties), or shielding of electromagnetic field. Magnetically modified (nano)textile also exhibits peroxidase-like activity. A new analytical procedure "Magnetic textile solid phase extraction" has been developed and used for the preconcentration of target analyzes. Magnetically responsive (nano)textile will certainly find other interesting applications in the near future.

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Experimental verification of a predictive model equation for thermal conductivity of ionic liquids

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Ionic liquids (ILs) have been recently proposed as components of heat-transfer fluids (HTF). The key property of HTF is thermal conductivity (TC). However, the measurement of the thermal conductivity of ILs can be challenging and time-consuming, therefore a good and reliable predictive model becomes desirable. In 2014 an equation using the speed of sound to determine the thermal conductivity of ILs was proposed[1]. In this work 1-alkyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imides ($[C_nC_1im][NTf_2]$, n = 2, 4, 6, 8), 1-ethyl-3-alkylimidazolium ethyl sulfates ($[C_2C_nim][EtSO_4]$, n = 1, 2), 1-ethyl-3-methylimidazolium tricyanomethanide ($[C_2C_1im][C(CN)_3]$) and 1-ethyl-3-methylimidazolium thiocyanate ($[C_2C_1im][SCN]$) were investigated. The TC of ILs was measured by means of transient hot wire method. The experimental TC was compared with the calculated results. The difference between measured and predicted values is significant and can exceed 20%.

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[1] Wu K.-J., Chen Q.-L., He C.-H. (2014), Speed of sound of ionic liquids: Database, estimation, and its application for thermal conductivity prediction, *AIChE Journal*, **60**(3): 1120–1131, doi: 10.1002/aic.14346.

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Assessment of the acoustic impact of a Wind Farm "GŁUCHÓW" during operation

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The paper presents the results of the research programme on the acoustic impact of the GŁUCHÓW Wind Farm, consisting of 10 VESTAS V90 wind turbine sets, each with a capacity of 2 MW. The generated sounds of all operating wind farms were recorded with 4 measuring sets.

This acoustic assessment included the recording of audible sounds range (20 Hz – 20 kHz) propagated directly from the tested objects. The acoustic assessment of the wind farm's impact on the acoustic climate was carried out in accordance with applicable Polish law, in the manner specified in the Regulation of the Minister of the Environment of September 7, 2021 (Journal of Laws of 2021, item 1710).

The performed tests were of a continuous (daily) nature, covering the time of day and night with simultaneous continuous recording of meteorological conditions. In the acoustic assessment, the directions, wind speeds and air temperature in the environment were taken into account. A new form of documentation and archiving of changes in the tested sound levels was presented, which is possible with usage of the latest equipment and software from SVANTEK. The acoustic power of the selected wind farm was estimated by numerical simulation based on the PN-ISO 9613-2 standard and on the basis of the performed tests. After obtaining the results of the acoustic power tests and the equivalent levels at reference points around the wind turbine generator farm, the ranges of acoustic propagation zones for the entire wind farm were generated. This assessment reflects the least favourable acoustic situation for the operation of a Wind Farm "GŁUCHÓW".

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Influence of selected parameters of the Doppler Tomography method on the quality of image reconstruction

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The Doppler Tomography method allows to obtain a cross-sectional image of the examined object. It is possible thanks to the use of ultrasound probe moving around the object. On the basis of registration of Doppler frequency changes from reflected signals it is possible to reconstruct the image. For this purpose the Filtered Back Projection algorithm is used.

The most important signal in this method is the so-called Doppler signal. It contains only the Doppler frequencies recorded during the measurement. It is possible to determine the formula on the basis of which it is possible to determine the waveform of this signal. This makes it possible to simulate any image.

This paper presents the influence of several selected parameters of the Doppler Tomography method on the quality of imaging. The examined object was an infinitesimally small point scattering the ultrasound wave in each direction equally. On its example it was possible to estimate the minimum size of the imaged inclusions.

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The effect of rotating and alternating magnetic fields on the thermal effect in magnetic fluids

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In general, the most promising materials for magnetic hyperthermia heating are based on iron oxide particle nanosystems. This is also indicated in some clinical trials studies in biomedical applications (hyperthermia, MRI, magnetic drug targeting) where iron-based oxides were used. In this contribution, magnetite nanoparticles of various configurations (single, chains from bacteria, halloysite chains, aggregated in bacterial cellulose) are measured in hyperthermia experiments. The physical principles of magnetic hyperthermia are based on the heat generation in systems of magnetic nanoparticles due to the influence of applied external magnetic fields such as AC and/or rotational magnetic field (RMF). The choice of a suitable set up for generating of magnetic field can significantly affect the resulting thermal effect and thus the efficiency itself. The technical details of the generating RMF as a new one compared to traditional AC magnetic field will be presented.

It would be good to emphasize that while the mechanisms (magnetic relaxations as Neel and/or Brown and hysteresis) of the temperature rise are in principle the same the heating effect depends on experimental conditions if AC or RMF is applied. It was found that the RMF produces increasing a thermal effect (in some cases two times larger) compared to AC field in measured samples mentioned above under similar experimental conditions. On the other hand, the difference in the efficiency of the RMF versus the AC field was more pronounced for individual nanoparticles than for systems containing chain nanoparticles for example.

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Location of leakage in metal pipelines by the acoustics emission method using modeled and natural sources

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

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