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Chronicle

51st Winter School on Wave and Quantum Acoustics Lth Winter School on Environmental Acoustics and Vibroacoustics Szczyrk, Poland, February 27 – March 3, 2023

On behalf of the Upper Silesian Division of the Polish Acoustical Society (the main organizer) and the Committee of Acoustics of the Polish Academy of Sciences (the co-organizer) we are pleased to announce that after many years of tradition, the abovementioned Conferences known as the "Winter Schools" have been organized and completed with success.

This year we were celebrating the Lth Winter School on Environmental Acoustics and Vibroacoustics, a conference well-known among Polish acousticians. For this reason, the "Winter Schools" began with a special, joined session dedicated to the celebration of this jubilee. As it has always been over the past 50 years of the conference history, Lth Winter School on Environmental Acoustics and Vibroacoustics was concerned with all environmental and vibroacoustics fields, but particularly with the traffic noise, vibroacoustics of machines, room acoustics, building acoustics, noise protection and similar problems. Many persons well-known from previous editions of the Conference joined us, either on-site or on-line. During the Conference, a seminar on "Industrial and Impulsive Noise" was organized in association with SVANTEK, which attracted 30 participants.

51st Winter School on Wave and Quantum Acoustics constituted platforms for sharing the results and achievements obtained in different branches of physical acoustics, as molecular acoustics, quantum acoustics, acousto-optics, magnetoacoustics, photoacoustics, acoustics of solid state, acoustic emission, and others. Moreover, researches in some selected topics related to those mentioned above (e.g., optoelectronics, relaxation processes) were presented during the school. The Conference consisted of the 18th Workshop on Acoustoelectronics and the 18th Workshop on Molecular Acoustics, Relaxation and Calorimetric Methods. However, the organizers are opened to organizing workshops on other subjects in the future. We would like to invite scientific centers and other professional groups to cooperate in organizing workshops on the subjects of their interests.

In summary, 51 persons participated in the Conferences and seminars, presenting 46 lectures, reports, and posters. In this issue, one can find abstracts of some lectures and posters, which were presented during the Conferences.

Further information about Conferences is available on our website:

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

Dariusz Bismor
Secretary of the Organizing Committee

Abstracts

Pickering droplets and liquid marbles as templates for the formation of capsules

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Various types of pharmaceutics can be delivered to the site of interest via encapsulation. The essential requirements for efficient capsule carriers include their durability, resistance against destabilization, and the robustness of the preparation technique. One of the possible approaches to fabricating such capsules, which can be used in biomedical applications, is using Pickering droplets, i.e., the droplets covered by solid particles, as templates and making their particle shell more rigid by sintering under high-amplitude alternating magnetic fields. In our work, we compared the capsules formed from Pickering droplets with those prepared using liquid marbles, i.e., droplets covered by particles residing at the liquid-air interface. The results suggest that both methods could be used for different purposes, depending on the possibility of locating magnetic nanoparticles as nano-heaters inside or outside the droplet. In the future, such fabricated capsules could be used in magnetically-responsive targeting of active substances, e.g., antibiotics.

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

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Structural active noise control using the leaky partial update LMS algorithms

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Structural Active Noise Control (ANC) systems are one of few solutions of the ANC problem which allow to obtain a global noise reduction effect. Unfortunately, due to high dimensionality of these multichannel adaptation systems, which use many sensors and actuators, structural ANC systems are systems with high computational power requirements. A promising group of methods allowing to reduce these requirements are partial update LMS algorithms. In this communication, a modification of partial update LMS algorithms with leakage is presented. The computational power savings are discussed, and two simulation setups are presented to test the leaky partial updates. The results of the simulations confirm the algorithms are stable and provide good attenuation results.

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Ultra-long carbon nanotube-paraffin composites of record thermal conductivity

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Phase change materials (PCMs) are capable of storage considerably more energy than conventional systems based on sensible heat. Despite immense and global research, there is a continuous pursuit for high-performance PCMs among which carbon nanocomposites emerge as the most prospective ones. Here, by comprehensive analysis of carbon nanotubes (CNTs) of three various morphologies (crystallinity, number of walls, and aspect ratio), we report record-breaking characteristics of CNT-paraffin nanocomposites based on ultra-long (770 μm) in-house multi-wall CNTs (MWCNTs) as fully functional PCMs prepared by a melting technique. By systematic investigations covering scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), and analysis of thermophysical properties, we have constructed the most promising MWCNT(0.5% wt.)-paraffin nanocomposite of 37%-enhanced thermal conductivity and 6.3%-higher enthalpy of the phase change (ΔHm), in reference to the base paraffin, as well as excellent cycling stability (>50 heating/cooling cycles), and as low supercooling temperature ($\Delta T = T_m - T_c$) as 2.4°C. The superior characteristics derive from more rapid nucleation of larger crystallites by MWCNTs proceeding via short- and long-range templating, as well as intrinsic characteristics of individual and fibrous ultra-long MWCNTs. Additionally, even a 161%-enhancement in thermal conductivity is available for the long MWCNT-paraffin composite, but at the cost of preserving the remaining thermophysical characteristics of neat paraffin. The results clearly point out the potential of the elaborated PCMs for thermal energy storage.

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System for monitoring and identification of vibroacoustic threats – SMIZW

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The presentation will discuss the System for Monitoring and Identification of Vibroacoustic Threats (SMIZW). The SMIZW system combines artificial intelligence and deterministic algorithms to automatically analyze measured noise for hazards that cause noise exceedances. The system is based on a system of independent sensors and performs automatic classification of acoustic events in real time and continuously creates a ranking of threats (noise sources). An integral part of SMIZW is a graphical user interface that allows simple operation of the system and generation of analysis reports.

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Comparative analysis of acoustic emission signals generated by the on-load tap-changer with regard to the possibility of detecting non-simultaneous operation

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The article presents the results of using acoustic method for diagnostics of the on-load tap changer. Measurements were carried out in laboratory conditions by simulating non-simultaneous operation on physical on-load tap-changer model. An oil-insulated tap-changer of the VEL-110 type, often used in polish power system, was used for the study. Measurements were made simultaneously using four piezoelectric transducers mounted on the outer wall of the tap-changer model. In addition, electrical measurements were carried out – ocsylographic method was used as well as the motor current in the device's drive system was recorded. The main goal of the research was to determine the possibility of detecting the nonsimultaneous operation of the tap-changer using piezoelectric

transducers with different transmission characteristics. Obtained results were correlated with oscillographic measurements. Sensitivity of piezoelectric transducers was specified to changes in the system. The results were analyzed in the time and time-frequency domain. The article also attempts to verify the feasibility of using selected acoustic signal descriptors to conduct diagnostics of on-load tap-changers for detection of non-simultaneous operation.

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Thermal properties of ionanofluids with functionalized multi-walled carbon nanotubes

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Ionanofluids (INFs) are systems containing ionic liquids (ILs) and dispersed nanoparticles therein. Our studies proved that the addition of non-functionalized multiwalled carbon nanotubes (MWCNTs) to ILs leads to an increase in thermal conductivity and has no effect on isobaric heat capacity (Jóźwiak *et al.*, 2020). On the other hand, functionalized MWCNTs may lead to an increase in isobaric heat capacity.

Thus, the main object of this study is to explore the thermal properties of INFs composed of different ILs and different functionalized MWCNTs. Additionally, the isobaric heat capacity of multi-ionic systems, a new class of INFs, is investigated.

The study shows that the addition of functionalized MWCNTs may lead to a slight increase in isobaric heat capacity, but at the same time it has a slight increase or no effect on thermal conductivity and viscosity. Proposed multi-ionic systems are promising but need to be further investigated.

This work was financially supported by the National Science Centre (Poland) Grant No.2021/41/B/ST5/00892.

Jóźwiak B. *et al.* (2020), Remarkable thermal conductivity enhancement in carbon-based ionanofluids: Effect of nanoparticle morphology, *ACS Applied Materials & Interfaces*, **12**(34): 38113–38123, doi: 10.1021/acsami.0c09752.

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Impact of wind turbines on people-field surveys and a series of laboratory experiments

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As part of the project "Healthy society-towards optimal management of wind turbines' noise (HETMAN)", a number of experiments are being carried out with the aim of comprehensively determining key parameters for wind turbine noise perception and investigating people's reactions to this type of noise. Several studies are currently underway, the preliminary results of which will be briefly discussed. We will present how the annoyance rating of this type of noise compares to road noise. We will describe the similarities and differences in conducting studies in situ and in the laboratory. We will show whether it is possible to mask turbine noise and discuss whether infrasound noise from turbines is indeed a significant perceptual factor.

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Ultrasound absorption and some rheological properties of 1-ethyl-3-methylimidazolium hydrogen sulfate ionic liquid

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Ionic liquids have gained increasing interest over a dozen last years, but only very little effort was spent in the study of ultrasound absorption in this still promising class of compounds. In this study, we present the results of ultrasound absorption measurements for 1-ethyl-3-methylimidazolium hydrogen sulfate. The ultrasound absorption in the frequency range (10 to 35) MHz and at temperatures from (293.15 to 323.15) K was measured by means of a standard pulse technique (first traveling pulse in the variable path length). The results reveal that the sample shows very high absorption, e.g., the frequency normalized absorption at 10 MHz and 293.15 K reaches $12500 \cdot 10^{-15}$ $s^2 \cdot m^{-1}$. Over the whole temperature and frequency measurement range, the relaxation of ultrasound absorption is clearly visible. Moreover, the negative temperature coefficients of normalized absorption are observed. The non-Newtonian properties (viscoelasticity) are detected as well.

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Numerical analysis and new formulas of the response stage of a new SAW structure with disappeared layer RR-P3HT in detection DMMP

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The paper presents the results of numerical analyses of the SAW gas sensor in the response 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 disappeared layer (RR)-P3HT in the response steady state have been shown. 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 and formulas based on signal theory – splice of the signal. Numerical results for profile concentration in response state have been shown and mathematical formulas. 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. The numerical results basing on the code written in Python, are described and analyzed. The theoretical results were verified and confirmed experimentally.

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Development of an autonomous, modular transport vehicle for performing logistics operations – vibroacoustic and dynamic issues at the design stage

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The aim of the NCBiR-subsidized project is to develop an autonomous, modular transport vehicle for performing logistics operations in indoor and outdoor environments with a vision, laser and radio-based navigation system. The AGV (Automated Guided Vehicle), with the working name T1500, will be characterized by its ability to perform transport operations efficiently in varied environmental conditions. Unlike most standard AGVs, which are only prepared to operate indoors, the T1500 AGV will also be able to perform transport tasks outdoor in adverse weather conditions such as frost, snow, fog or light rain.

Advanced vehicle control algorithms include not only terrain-map-based route optimization and effective obstacle avoidance strategies, but also methods based on learning and selecting the most appropriate route on the basis of statistics on previously made journeys. Particular attention was paid to safety of the vehicle, its working environment and the transported goods. For this purpose, the type of goods to be transported is identified acoustically and dynamically and the control algorithm of the vehicle is adjusted correspondingly with the goods particularly difficult to be transported.

The article describes the results from load dynamics tests and the concept of implementing the recognition of dangerous situations during passage on the basis of an acoustic signal developed with the MATLAB program, with the use of neural networks.

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Ultrasound study of magnetic pickering emulsions

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Ultrasound spectroscopy provides interesting results useful in material science, especially when studying suspensions and emulsions. In this research, we used this technique to investigate the stability of magnetic Pickering emulsion, an emulsion stabilized by nanoparticles accumulated at the droplet surface as a shell form. The ultrasound scattering theory based on the core-shell model was applied to determine the ultrasound attenuation and interpret the data from experiments. The implemented model considers the thermal, density, and compressibility contrast between emulsion phases during ultrasound wave propagation. Ultrasound attenuation in the function of frequency was calculated for different core radii and shell thicknesses and fitted to the experimental attenuation spectra. The results show that ultrasound attenuation spectroscopy can be used to study the size of magnetic Pickering droplets and the thickness of the particle shell when different volume fractions of magnetic nanoparticles were used to stabilize the emulsion. The knowledge of shell stability is crucial from the perspective of the application of Pickering emulsions in industry and biomedicine; therefore, the non-destructive technique that can efficiently characterize such a complex, three-phase system is desirable.

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Salty carbon nanotubes

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Synthesized by catalytic chemical vapor deposition (c-CVD), ultra-long, multi-walled carbon nanotubes can be chemically modified to enhance and target chemical and physical properties. It seems that systems consisting of cationically/anionically modified carbon nanotubes will significantly modify the conductivity of hybrid and composite systems. In this work, examples of the creation of such modified systems with the participation of carboxylated and aminated carbon nanotubes are presented.

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Fabrication, properties and applications of 1D microparticle structures

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1D micro-particle structures have been extensively studied over the past few decades. The selective distribu-

tion of microparticles in a form of predefined patterns found interest among others in the fields of electronics, microrobotics, and biosensors.

Depending on the application purpose, complex morphologies can be created by the assembly of microparticles with different shapes i.e., spheres, Janus dimers, polyhedrons, rods, and ellipsoids. To assemble, such various building blocks into 1D structures, electric, magnetic, acoustic, and optic field-assisted assembly methods are commonly used. Our group led by prof. Rozynek recently developed a simple and efficient approach that combines electric and capillary interactions. The novelty of our method is the ability to efficiently assemble long 1D structures outside a liquid environment.

The most interesting assembly methods, properties, and applications of 1D microstructures presented over the years including our approach, colloidal caterpillars for cargo transportation, bending responsive hydrogels, colloidal origami, and microrobot assemblies will be discussed.

This work was supported by the Polish National Science Centre through the OPUS17 programme (2019/33/B/ST5/00935).

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Contrast-enhanced magneto-motive ultrasound for sentinel lymph node identification

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Identification of cancerous lymph nodes is crucial for cancer staging. The absence of metastases in the sentinel node is a good prognostic factor, as it determines the lower probability of metastasis in other draining nodes. Localization of sentinel lymph nodes is not an easy task. Commonly used in clinical practice methods, such as blue dye staining or isotope staining, are lacking accuracy.

As an alternative tool for lymph node identification Contrast-Enhanced Magneto-Motive Ultrasound (CE-MMUS) has been proposed. CE-MMUS uses magnetic nanoparticles and microbubbles as contrast agents, and a low-frequency alternating magnetic field to induce oscillations of magnetic microbubbles to generate tissue-laden movement.

Results showed that magnetic microbubbles can be successfully used as bimodal contrast agents. Microbubble accumulation was verified using contrast-enhanced ultrasound, and their presence visibly increased the echogenicity of the sentinel lymph node. Tissue-laden movement was tracked and filtered out with a phase and frequency tracking algorithm. Mean tissue displacement caused by microbubbles increased compared to displacement caused by magnetic nanoparticles only. The studies were conducted on mice models in vivo.

This work was supported by CRUK-grant numbers A23333/24730.

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Urban green infrastructure as a moderator of physical environmental factors – an acoustic-electromagnetic example of criteria for multi-factor assessment

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Urban green infrastructure can, among other things, act as a moderator of various parameters of physical environmental factors (as their source or as a barrier for propagation). For this reason, a properly selected structure of green infrastructure can be used to create microenvironments in the work or non-professional life environments that are conducive to recreation during the working day or in leisure time. Evaluation of the quality of such micro-environments requires appropriate research methods and criteria for multi-factor assessment, regarding physical environmental factors which are relevant for health, well-being and efficiency at work.

The core elements of multi-factor assessing the barrier capacity of green urban infrastructure will be presented, based on the preliminary results of pilot study, for acoustic and electromagnetic factors (taking into account their most common urban sources and their relevant parameters recognized in Warsaw – traffic noise and radiocommunication networks).

National Program "Governmental Program for Improvement of Safety and Working Conditions"; supported from the resources of the National Centre for Research and Development; research task IV.PN.05.

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Magnetic nanoparticles from nature – physical properties and possible applications in biomedicine and biotechnology

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Magnetic fluids as one of the pioneers of modern nanotechnologies are still attractive for basic as well as applied research. Magnetic fluids have prompted further research, especially in the field where nanoparticles, especially magnetic ones, give them the ability to manipulate them in an external magnetic field thus change the properties required in various applications. In recent years, development

of magnetic nanoparticles has been in the forefront of material research and development. Various methods have been developed to reach a better quality of samples for further application in technology. Almost all living systems, including bacteria, plants, animals, and humans, can create iron-based nanoparticles coated with apoferritin. Such stored iron forms ferritin, 10–12 nm metalloprotein magnetic particles. Magnetotactic bacteria create magnetosomes for example. Such bioinspired magnetic particles can be used in all applications that provide magnetic fluids, but they are unique in that they were created by nature or were inspired by nature. Due to their biocompatibility, they are much better usable in biomedical and biotechnological applications than artificially prepared magnetic particles. In lecture will be presented new results associated with these nanoparticles such as their structural and magnetic characterization as well as examples for biomedical, diagnostic or environmental engineering.

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Measurement and analysis of wind turbine noise

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The subject of the research concerns the analysis of noise emitted by a working wind turbine in field conditions. The studies carried out were intended to indicate the potential frequency range of emitted noise in the low frequency range and in the range heard by humans. Acoustic signals generated by the wind turbine were recorded using three independent measuring tracks, which were synchronized with each other. The obtained results will be used to determine the indicators for the studied frequency ranges, which will be the subject of further research work.

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Innovative solutions of people and the environment protection against rail traffic noise

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The increase in the speed of rail vehicles and the increased volume of train traffic causes increased noise emissions, which can have a negative impact on people and the environment. To minimize this negative impact, various methods of reducing noise emissions into the environment are routinely used. However, traditional methods are not always applicable or bring satisfactory results, e.g., noise barrier. An alternative to them may be innovative solutions, such as dampers of the rails and track suppressors, which was the subject of the research grant "Innovative solutions to protect people and the environment against rail traffic noise – InRaNoS" The main goal of this project was to develop guidelines for the use of noise mitigating devices on railway lines. The guidelines was based on tests results for two types of devices (dampers and track suppressors).

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Detection of drone eviction from the hive based on audio signal

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Eviction of drones from the hive in summer, may be the first sign of swarming. This is a potentially dangerous situation, as the queen and the entire hive may escape. To prevent this, we propose an early swarming detection system based on the behaviour of bees near the hive entrance. The system analyzes sound signals recorded at the entrance of the hive by an autoencoder neural network to detect ejected drones. Simulations using real signals have shown that it is possible to effectively detect drones ejected from the hive. The achieved detection probability of 86% makes it possible to create an effective alarm system for beekeepers.

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Acoustic noise in hatching plants as element of environment and its influence on the animal welfare

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Acoustic communication of chicks and ducks inside the egg before hatching is an important element of hatch synchronization in precocial species. Noise of various origins is characteristic of the artificial environment. This can negatively affect hatching. Measurements and registrations were carried out in the large poultry hatchery for chicks and ducks: setters, hatchers. Some noises of working machinery and animals were registered in: technological halls, corridors, storerooms, technical rooms. The registrations were analysed in Cool Edit Pro 2.1 tool in the wave form for the sound and noise presented in the signal for every measured points (FFT analysis were done).

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Design of a matrix sound source with controlled directivity characteristics

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Sound messages, including voice messages, play an important role in the work environment and in the living en-

vironment. With their help, information that is important at a given moment, in particular warnings about dangers, is provided to interested persons. For bystanders, however, a sound message can be an annoying noise, therefore it is recommended to construct electroacoustic systems for transmitting sound messages in such a way that the signal emitted by them reaches mainly interested people and minimizes noise pollution of the environment. One of the possible solutions is the use of sound sources with controlled directional characteristics. The paper presents the design of a sound source in the form of a matrix of dynamic loudspeakers with controlled directivity characteristics. The results of numerical simulations related to controlling the directionality characteristics of sound sources and related acoustic field distributions are presented. Simulation calculations were carried out using dedicated software developed for research purposes. Possibilities of controlling the directivity characteristic of the matrix source were discussed, and then the design of the electronic control system was proposed.

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Monitoring and control of vibroacoustic hazards in the work environment using the Internet of Things – review of issues and system proposal

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The work environment is an environment in which factors harmful to the health of employees may occur. A physical factor's potential harmfulness to health on the intensity of a given factor in the work environment and on the exposure time of the employee. The intensity of the harmful factor can change over time, sometimes in a way that is difficult to predict, causing increased risks to the employees. Detection of the threat and quick and effective response aimed at limiting its impact on the employee's health is possible in such cases, assuming continuous monitoring of the parameters of the working environment. The paper discusses issues concerning wireless sensor networks and the Internet of Things used for monitoring and controlling environmental parameters. A proposal for the structure of the system for monitoring and remote control of vibroacoustic hazards in the work environment has been presented. The technical possibilities of implementing the components of the system were discussed.

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Development of the SAFE website in the context of changes in the Polish labour 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 consists 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 labor market related in particular to economic immigration.

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Differences in acoustic features between the standard and the new variant of Polish /ɕ/

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The paper presents an examination of differences in selected acoustic features between two variants of the Polish alveolo-palatal voiceless sibilant, the standard realization of /ɕ/, and its fronted palatalized version [sj]. Four spectral parameters, namely standard deviation, skewness, kurtosis, and center of gravity (COG) are analyzed in search of significant and distinctive spectral features of the tested fricative segments. Differentiation in the use of the two variants among the speakers and their occurrence depending on the preceding vocalic contexts are focused on, as well. Statistical tests reveal significant differences between the two variants of the Polish phoneme in COG for the middle portion of the segment located after three non-high vowels: /ɛ, ɑ, ɔ/.

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Prediction of vibration transmission through technical connectors of various complexity

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The paper compares the results of simulations and measurements of vibration transmission through selected technical connectors. The tested joints were characterized by various degrees of complexity. The increasing advantage of experimental methods over simulation methods, when the degree of complexity of connections increases, has been indicated. Continuous joints (welded) and point joints (welded, riveted, bolted) were considered. During the experiments, the PIM (Power Injection Method) method was used to determine the CLF (Coupling Loss Factor) coefficients describing the vibration transmission. The results of the CLF simulations came from the developed FEM (Finite Element Method) models and from the theoretical dependencies derived from the wave theory. A good agreement between the simulations and measurements was ob-

tained for the welded joint, while a significant discrepancy occurred for point joints. Problematic features of point joints causing difficulties in developing their exact numerical model were indicated.

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New trends in housing construction – a difficult challenge for building acoustics

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New trends in residential construction direct its further development towards a lightweight prefabricated structure that is thermally effective and meets the criteria of sustainable development. Acoustic properties of this type of objects are a big challenge. Due to the low mass of building partitions, it is necessary to use specific structural details and additional insulating layers limiting the transmission of airborne and impact sounds. The paper presents an analysis of the impact of these solutions on the acoustic parameters of walls and floors, carried out on the basis of laboratory test results. The main objective of the work was to assess the effectiveness of various types of cladding and structural dividers in relation to lightweight partitions with a frame structure and floors consisting of composite panels. Additional suspended ceilings and floor coverings as well as thermal insulation of external walls were considered. Typical floating floor systems gave a weaker acoustic effect than when they are used on traditional massive floors. In the case of wall claddings and suspended ceilings, the use of elastic connectors and flexible suspenders limiting the transmission of structural sound was of great importance. The individual layers of the partition mutually interacted, so their effectiveness was not subject to simple summation. The presented analysis, results and conclusions may be useful in the design of lightweight prefabricated buildings and in the development of construction details that increase the acoustic efficiency of new solutions.

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Refraction analysis of divergent ultrasound beam transmitted through a coronal section of a female breast immersed in water

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The analysis of the phenomenon of ultrasound beam refraction is important in ultrasound imaging in developing methods to reduce the effects of this phenomenon. The propagation paths of ultrasound beam rays in soft tissue are not rectilinear, leading to distortion of the imaged structures. This is particularly important for imaging the breast structure by quantitative ultrasound transmission tomography, as the pixels in the image present absolute local values of propagation speed and attenuation, which are the basis for diagnosing pathological changes. The phenomenon of refraction affects the deformation of visualized lesions and falsifies the distribution of the values of the acoustic parameters. The study modeled the refraction phenomenon of divergent ultrasound beam transmitted through a circular section of breast glandular tissue surrounded by subcutaneous fat, skin, and water. The developed model makes it possible to change the size of the section and layers, the ultrasound velocity in each medium, and the temperature of the water. With the help of the developed model, different scenarios of the refraction phenomenon were analyzed for the possibility of its reduction. Control tests of the same female breast in vivo at different water temperatures were also performed using the ultrasound tomography breast scanner prototype.

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Wind turbine noise annoyance due to the possibility of the employee carrying out works requiring attention

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The constant growth of energy demand, as well as the accompanying increase in environmental pollution resulting from the prevailing use of fossil fuels, has led to a rising use of energy from renewable sources. According to the data of the Statistics Poland of 2021, energy from renewable sources in Poland in 2020 mainly came from solid biofuels (71.61%), wind energy (10.85%) and liquid biofuels (7.79%). The use of wind turbines to generate electricity has many obvious advantages, such as lack of fuel costs during operation and lack of harmful pollutants, including CO_2. Despite advantages, the use of wind energy (wind turbines) constantly raises questions and concerns. The questions concerning the impact of wind farms on humans still remain valid. This impact includes many factors related to the operation of wind farms, and in particular noise emitted by these farms. The wind turbine noise impact on humans has been studied by the Central Institute for Labour Protection – National Research Institute, but unlike other studies it focused on the impact of this noise as an annoyance factor affecting the employees' capacity to perform their basic tasks. Taking into account the obtained results, it was concluded that wind turbine noise with an equivalent A-weighted sound pressure level of at least 50 dBA should be considered as a noise nuisance due to the possibility of the employee carrying out works requiring attention.

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Effect of ultrasonic noise on humans

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Ultrasonic noise can be harmful to the hearing organ, as well as negatively affect the vestibular system, which may

be manifested by headaches, dizziness and balance disorders. The last revision of the limit values for ultrasonic noise took place in 2001 and was based, among others, on based on the WHO guidelines from 1982 and the IRPA from 1984. The limit values adopted in Poland and in other countries are largely based on the results of research from the 70s and 80s. It should be emphasized that many of these scientific reports have not been confirmed by other researchers. The paper presents current literature reports on the impact of ultrasonic noise on humans in the context of the applicable limit values.

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From magnetic adsorbents to magnetically responsive nanozymes

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Currently there is a high interest in the study and potential applications of magnetically responsive adsorbents for the removal of wide variety of inorganic and organic pollutants. Special attention is paid to low-cost (bio)sorbents including food and agricultural wastes, microbial cells, macroalgae, biochar or clays. Simple and inexpensive magnetic modification procedures, employing, e.g., magnetic fluid treatment, mechanochemical procedure or microwave assisted synthesis have been developed. In most cases nano- and microparticles of ferrimagnetic iron oxides (magnetite, maghemite or different types of ferrites) are used for (bio)sorbent modification. Both magnetite and maghemite exhibit peroxidase-like activity and belong to a wide group of nanozymes. Magnetically modified materials (adsorbents) can thus exhibit dual activity, where both adsorption and enzyme-like degradation can be applied for specific pollutants removal. Various types of magnetically modified materials developed by the authors will be presented in the lecture, together with their characterization and potential applications.

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New two-step non-ultrasonication method of preparation of ionanofluids

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Multi-walled carbon nanotubes (MWCNTs) dispersed in ionic liquids (ILs), also known as ionanofluids (INFs), have greatly thermal conductivity (TC) increased compared to the base IL. Thus, INFs can be considered as new heat-transfer fluids (HTFs). INFs containing long MWCNTs have higher thermal conductivity than INFs with short MWCNTs (Dzida *et al.*, 2020; Jóźwiak *et al.*, 2020) Only the long MWCNTs create subzipped networks and connect in multiple bridges (Dzida *et al.*, 2020) which suggests that the length of MWCNTs plays a key role in the TC enhancement. However, the ultrasound sonication applied during INFs' preparation shortens the MWCNTs (Jóźwiak *et al.*, 2021). In order to preserve the MWCNTs' length we developed a new, repeatable method of preparation of INFs without applying the ultrasonication. This method allowed to obtain long-term stable INFs with the TC increase of 60% for 1.0% by weight of long in-house MWCNTs dispersed in 1-ethyl-3-methylimidazolium thiocyanate at 298.15 K which is larger by 20% than for the same INF prepared using ultrasonication method (Jóźwiak *et al.*, 2020). On the other hand, the viscosity is also higher which can be a disadvantage when designing an INF with optimal both thermal and rheological properties.

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The impact of alternating and rotating regimes on the heating characteristics of magnetic fluid

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Magnetic nanoparticles can be used in numerous therapeutic procedures, including controlled drug delivery and release, thermal therapy, and photo- and sonodynamic therapy. However, such approaches remain limited due to difficulties associated with accurately controlling their therapeutic efficiency and localized consequences. In this contribution, magnetite nanoparticles of various configurations (single, chains from bacteria, halloysite chains, aggregated in bacterial cellulose) are measured in hyperthermia experiments. 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. Comparison of specific absorption rate (SAR) values for various magnetically modified biocarriers can be one of the parameters for the selection of optimal materials for potential hyperthermia applications.

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Calibration of vibration measuring instruments using comparative methods in Central Office of Measures

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Laboratory of Mechanical Vibrations in Central Office of Measures has an ability to calibrate vibration measuring instruments using laser interferometry method (on national measuring stand) and also using secondary calibration method according to *ISO 16063-21: 2003 Methods for the calibration of vibration and shock transducers – Part 21: Vibration calibration by comparison to a reference transducer*, which is carried out on independent measuring stand.

Purchasing in 2003 another measuring system for calibration using laser interferometry method (mentioned above) made it possible to expand calibrating possibilities of the Laboratory especially in range of obtained measurement uncertainties. Personnel changes in recent years in Laboratory caused interest in other possibilities of this measuring system. As a result, there is a possibility to calibrate vibration instruments using secondary method also on this measuring stand and there is also possibility to carry out calibration using SWEEP signal. This paper shows actual measuring systems of secondary method working in Laboratory of Mechanical Vibrations, presents the results of conducted measurements of vibration transducer with an interpretation using two different types of exciters (two measuring stands) and at the end, presents calibration results using SWEEP signal.

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Partial discharges research by acoustic emission method and by electric and acoustic emission methods used in parallel

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Original multi-channel author's measurement systems designed and built to conduct research on PDs phenomena using the AE method are presented. The systems provide real-time monitoring and recording of signals as well as analysis of recorded signals. The analysis of the recorded AE signals is carried out in the following domains: time, frequency, time-frequency and discrimination threshold. In particular, in the domain of the discrimination threshold, the AE descriptor has been defined with the ADC acronym, which ranks the signals according to the so-called degree of advancement. The conducted parallel tests carried out by the electrical method and the AE method showed that, for a single PD source, the ordering of signals using the ADC descriptor is identical to the ordering of sources according to the value of the introduced apparent charge.

The paper presents the author's method of locating and identifying PDs in selected real objects: coil rods of hydrogenerators, power oil transformers. The results of PDs tests of power oil transformer at the test station, conducted in parallel with the electric method and author's AE method, and the results of PDs tests in 3 selected transformers carried out, during ongoing in-situ operation, using the AE method are presented. Based on the results of these tests, the authors made diagnoses of the condition of the insulation systems in the tested transformers. The inspections of these transformers confirmed the diagnoses.

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