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**Abstracts**

**Low Noise Pavements in Germany:  
Established Concepts and New Ideas**

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Traffic noise, and road traffic noise in particular, is a problem to be solved in densely populated regions worldwide. Tire-road noise is the main source for road traffic noise and low-noise road surfaces are an effective measure for its reduction. In Germany, most low-noise surfaces are built in asphalt, giving a good acoustic performance whereas their durability under heavy traffic is not optimal. Concrete, instead, is very durable and ideal for roads under heavy traffic, but there are only a few concepts of low noise concrete road types. In several research projects a number of low-noise concrete road surface concepts have been investigated, including the optimization of standard road surfaces like exposed aggregate concrete or the postprocessing of concrete roads by diamond grinding. In addition, several new surface types have been developed from a virtual design, taking into account the deeper understanding of tire-road noise generation: these concepts include specifically designed road surface textures, novel materials for road construction such as ultrahigh performance concrete or specially designed porous materials.

The paper resumes the well-established low noise road surface concepts used in Germany and the outcomes of the above-mentioned research projects.

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**Active Vibration Reduction  
of Ship Propulsion Systems**

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Demands on the development of ship propulsion systems are an increase of efficiency and its vibro-acoustic behaviour. The paper gives an overview of the development methodology of active measures to reduce torsional and translational vibration of a ship propulsion system. Based on experimental investigation of a ship, a numerical model of the propulsion system is setup and updated by experimental results. The simulation model includes the rotational and translational vibration behaviour. The model structure follows an admittance-impedance description that is most suitable for the design of active vibration control systems. Different concepts for reducing vibration are evaluated and compared numerically compared. The realized systems are characterized in a propulsion system testing environment and eventually implemented in the real ship. Examples of realized measures as an inertial mass actuator and an energy-harvesting absorber are presented.

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**Decibel Algebra in Acoustics**

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**Digitally Controlled PA-Systems in Churches**

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Room-acoustic conditions in churches, especially in old large churches protected as buildings of historic impor-

Example (QBE), Query-by-Category (QBC), music content, music annotating, music tagging, bridging semantic gap in music domain, etc. is introduced. Bases of music recommender systems are shortly presented, including mechanisms underlying these systems. Also, usage of machine learning versus statistics is discussed with regard to the recommender systems working. Moreover, listening to music through players implemented on computers or mobile devices is opposed to listening to live music in the context of social and technology implications, i.e. live performance contrasting issues related to music quality. Finally, future directions in the music recommendation area and live music are discussed, including performance on virtual musical instruments.

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### Measurement Methodology for Interiors Coupled with Sound Reinforcement Systems

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This paper presents a description of the methodology of performing acoustic measurements in acoustically difficult enclosed spaces in order to obtain a repository of impulse responses. As a part of the research, acoustic parameters important in the context of public address and sound reinforcement systems were first reviewed. A measurement methodology was proposed that employed various test signals to determine impulse responses. In addition, in the process of evaluating the sound system performance, signals enabling direct objective measurement of the STI (Speech Transmission Index) coefficient, and in particular the STI-PA (STI for Public Address systems) ratio, were utilized in accordance with the measurement standard. Sound systems installed in the selected acoustic interiors were used in the measurements. A comparison of the results obtained for different length of Sweep Sine stimuli was made that enabled to recommend the latter test signal as more suitable for such interiors coupled with sound reinforcement systems.

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### Effects of Fast-Acting Hearing-Aid Compression on Audibility, Forward Masking and Speech Perception

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Dynamic range compression (DRC) is a widely-used compensation strategy in hearing aids. However, the choice of the compression parameters, such as time constants, is still a subject of an ongoing debate. This contribution evaluates the efficacy of fast-acting DRC as a hearing-loss compensation strategy in a range of experimental conditions. First, fast-acting DRC was investigated considering temporal masking of narrowband stimuli. The results of a model-driven evaluation showed that the measures of temporal resolution can be improved with fast-acting compression with a very short release time (10 ms). Second, the effects of compression on speech audibility and noise-induced forward masking were evaluated in a highly-controlled scenario. The application of very short compression time constants was shown to improve HI listeners' consonant recognition performance. Finally, despite the benefits of fast-acting compression apparent in controlled conditions, it may introduce distortion in realistic scenarios, such as a reduction in the signal-to-noise ratio (SNR). A novel signal-to-noise-ratio-aware compensation strategy is discussed, which switches between fast- and slow-acting compression depending on the presence of the target signal and therefore preserves the natural relationship between the target and the background. An objective evaluation of the algorithm is presented and its potential applications are discussed.

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### How to Adjust Room Acoustics to Multifunctional Use at Music Venues

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Multifunctional venues such as local culture centres have to be flexible to host many different kinds of concerts, theatre shows, and various other events. Additionally, many existing venues such as theatres, concert halls, and even opera houses need to present shows which are not typical for their purpose. This situation caused a strong need to change acoustic parameters of the venue between different types of events. The paper presents a few ideas on how to meet this need, based on several realized music venues. Technologies used to change room acoustics are explained, as well as final results taken by acoustics measurements.

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### Ultrasound Thermal Effect Enriched by Adding Micro and Nano Particles to Tissue Mimicking Materials

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Agar-gel based materials are widely used as tissue mimicking materials. Pure agar-gel is stable up to 60°C but

exhibits small ultrasound attenuation compare to a soft tissue. To enhance the attenuation of agar-gel we fabricated samples of agar-gel with adding of graphite micro particles (GMPs), magnetic micro particles (MMPs) and magnetic nano particles (MNPs) with two weight fractions of dry powders added before the formation of the gel to the aqueous agar solution, namely 0.8% and 1.6%, respectively. In order to compare the thermal effect caused by addition of particles, the samples immersed in a water bath were heated by 2 MHz circular focused transducer (diameter 44 mm), with power of 1, 2, 3 and 4 W. The temperature increase curves were measured by thermocouples. The temperature change rate (TCR) in the initial point of heating was calculated. For 0.8% weight fraction the MMPs sample had the highest TCR value at each sound power tested, the smallest value had the MNPs sample. For the 1.6% weight fraction, the highest TCR value had the MNPs sample, while the smallest TCR had the GMPs sample. We stated that for the higher fraction of particles, the MNPs material had the highest TCR value for all powers, and besides the difference between TCR in MMPs and GMPs samples was less than the difference between TCR in MMPs and MNPs samples. Besides, in this case, the MNPs sample exhibited the minimal exposure time to achieve the temperature increment of 5°C, which was only to 6 s for the acoustic power of 4 W. This facts underline the unique properties of MNP material and its usefulness as a model material for ultrasonic hyperthermia experiments.

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#### Acoustic Detection of Macroalgae in a Dynamic Arctic Environment (Isfjorden, West Spitsbergen) Using Single- and Multi-Beam Echosounders

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Acoustic imaging of seabed morphology and benthic habitats is a fast-developing tool for investigating large areas of underwater environment. Even though single- and multi-beam echosounders have been widely used for this purpose for many years, there is still much to discover, especially in terms of processing water column echoes to detect macroalgae and other scatterers (e.g., fishes, or suspended sediments).

In July 2016 and 2017 eight areas (4 northern and 4 southern of the fjord) were mapped in Isfjorden (Svalbard) using single-beam sonar Biosonix DTX (420 kHz) and multibeam sonar Norbit iWBMS (330 kHz). These multi-disciplinary expeditions to investigate macroalgae spatial distribution in areas under the increased influence of glacial melt water were founded by Polish National Science Centre (project MAKAK: UMO-2015/17/B/NZ8/02473).

We covered 6.6 km<sup>2</sup> of seabed in shallow, coastal zone, collecting a unique data set showing variability of acoustic properties among different macroalgae species, supported by very well correlated ground-truth data (video) and environmental measurements (CTD, ADCP).

Using modern processing techniques we analysed morphology, backscatter intensities and water column data signals of both acoustic instruments allowing us for kelp detection. We also demonstrated high efficiency of compact multibeam systems for benthic habitat mapping in Arctic conditions.

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#### Highly Impulsive Noise of Collisions of Train Cars: Distinctive Feature Vector Development

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The issue of objective assessment of impulsive noise still remains one of the important problems of environmental acoustics. Current, arbitrary classification methods partly solve the problem of identification, but the issue of differentiating the degree of annoyance of highly impulsive and also high-energy sound sources is still unresolved. Therefore, it is reasonable to search for effective methods in the process of objective assessment and classification of highly impulsive noise. As one of the possible approaches, the authors find the application of artificial intelligence methods.

The paper presents a proposal of a vector of distinctive features of highly impulse noise from collisions of train cars, which can be useful in the classification of impulses due to their degree of annoyance. A set of measurable parameters in time and frequency domain have been selected for the construction of the feature vector. Their usefulness in the classification of the impulses has been verified on the basis of principal component analysis and cluster analysis.

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#### On Some Problems with Vibroacoustic LDV Measurements for Windows

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Acoustic insulation of windows was tested with the help of laser Doppler velocimeter (LDV). LDV in window research could, for example, checks the correctness of the window fixing and determine the map of acoustic energy passing through the window. During testing, a very large 3-wing window, overheated of the loudspeaker occurred in the transmitting chamber and jumps in the emitted acoustic power appeared. For the saving of the measurement results after overheating the loudspeaker, the correction of results in the final part of the examined area was applied. Problems with correcting these results are described in the article.

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