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Houcine Ayari, Marc Thomas, Sylvie Doré. *A Design of Experiments for Statistically Predicting Risk of Adverse Health Effects on Drivers Exposed to Vertical Vibrations*. S. 221-232.

An injury risk factor (IRF), which indicates the risk of adverse health effect to lumbar rachis arising from mechanical vibrations, is developed. Experiments have been conducted that consider acceleration levels at the seat of drivers, posture, morphology, density, damping rate and body mass as independent variables. A parametric finite-element model of the lumbar rachis has been generated. It is shown that the IRF increases with ageing and an IRF of 30% is proposed as a threshold for fatigue purposes. This level is reached if a peak acceleration level greater than 3 m/s² is applied to a light (55 kg) and an old driver with a low bone density and a damping rate of 20%. This vibration threshold must be reduced to 2.7 m/s² if the driver's weight increases to 75 kg and to 2 m/s² if the driver is heavy (98 kg).

Eleonora Carletti, Francesca Pedrielli, Camilla Casazza. *Development and Validation of a Numerical Prediction Model to Estimate the Annoyance Condition at the Operation Station of Compact Loaders*. S. 233-240.

This paper describes the results of a study aimed at developing and validating a prediction model to assess the annoyance conditions at the operator station of compact loaders by using noise signal objective parameters only. For this purpose, binaural measurements were carried out on 41 compact loaders, both in stationary and real working conditions. The 62 binaural noise recordings were objectively analysed in terms of acoustic and psychoacoustic parameters and then divided into 9 groups and used in specific jury tests to obtain the subjective annoyance scores. Finally, multiple regression technique was applied to the first 6 groups of noise stimuli to develop the model while the remaining groups were used to validate it.

Piotr Kowalski. *Examining the Effectiveness of Anti-Vibration Gloves With a Neural Network*. S. 241-247.

Whether anti-vibration gloves are effective in protecting against vibrations depends not only on the materials they are made of, but also on the parameters of the source of vibration. Depending on those parameters, the effectiveness of the same means of

protection may be radically different. This article presents a methodology of using a neural network to test anti-vibration gloves. A network can map gloves in various conditions, i.e., for vibrations of various amplitudes and spectra, and for various forces exerted by the worker on a tool. Real, measured vibration signals produced by different tools were used in training a neural network. The results presented in this article prove that real properties of gloves are accurately represented by their models developed as a result of training a neural network.

Emil Kozłowski, Jan Żera, Rafał Młyński. *Effect of Musician's Earplugs on Sound Level and Spectrum During Musical Performances*. S. 249-254.

In this study, change in A-weighted and 1/3-octave sound pressure levels (SPLs) was used to assess the influence of wearing earplugs by musicians on their musical performances. Seven soloists and 3 music assembles performed 4 pieces of music with musician's earplugs donned and doffed. They used silicon custom moulded earplugs with acoustic filters designed to attenuate sound by 9, 15 or 25 dB. Results showed that the use of earplugs affected the sound level and the spectrum of played sounds. This effect was the greatest for brass players. The difference between SPLs in high-frequency 1/3-octave bands and A-weighted SPLs with and without earplugs exceeded 5 and 15 dB, respectively. Similar changes for woodwind, percussion and string instruments were less noticeable than for brass instruments; they were more than 5 dB for 1/3-octave spectra and no more than 2 dB for A-weighted SPL.

Małgorzata Pawlaczyk-Łuszczyńska, Adam Dudarewicz, Małgorzata Zamojska, Mariola Śliwinska-Kowalska. *Evaluation of Sound Exposure and Risk of Hearing Impairment in Orchestral Musicians*. S. 255-269.

This study aimed to assess exposure to sound and the risk of noise-induced hearing loss (NIHL) in orchestral musicians. Sound pressure level was measured in 1 opera and 3 symphony orchestras; questionnaires were filled in. On the basis of that data, the risk of NIHL was assessed according to Standard No. ISO 1999:1990. Classical orchestral musicians are usually exposed to sound at equivalent continuous A-weighted sound pressure levels of 81−90 dB (10th−90th percentiles), for 20−45 h (10th−90th percentiles) per week. Occupational exposure to such sound levels over 40 years of employment might cause hearing loss (expressed as a mean hearing threshold level at 2, 3, 4 kHz exceeding 35 dB) of up to 26%. Playing the horn, trumpet, tuba and percussion carries the highest risk (over 20%).

Janusz Piechowicz. *Estimating Surface Acoustic Impedance With the Inverse Method*. S. 271-276.

Sound field parameters are predicted with numerical methods in sound control systems, in acoustic desings of building and in sound field simulations. Those methods define the acoustic properties of surfaces, such as sound absorption coefficients or acoustic impedance, to determine boundary conditions. Several in situ measurement techniques were developed; one of them uses 2 microphones to measure direct and reflected sound over a planar test surface. Another approach is used in the inverse boundary elements method, in which estimating acoustic impedance of a surface is expressed as an inverse boundary problem. The boundary values can be found from multipoint sound pressure measurements in the interior of a room. This method can be applied to arbitrarily-shaped surfaces. This investigation is part of a research programme on using inverse methods in industrial room acoustics.

Dariusz Pleban. *A Global Index of Acoustic Assessment of Machines : Results of Experimental and Simulation Tests*. S. 277-286.

A global index of machines was developed to assess noise emitted by machines and to predict noise levels at workstations. The global index is a function of several partial indices: sound power index, index of distance between the workstation and the machine, radiation directivity index, impulse and impact noise index and noise spectrum index. Tests were carried out to determine values of the global index for engine-generator; the inversion method for determining sound power level was used. It required modelling each tested generator with one omnidirectional substitute source. The partial indices and the global index were simulated, too. The results of the tests confirmed the correctness of the simulations.

Shaw-Ching Sheen. *Noise Generated by Multiple-Jet Nozzles With Conical Profiles*. S. 287-299.

Conical multiple-jet nozzles, which reduce the risk of nozzle openings being blocked, are tested for their effectiveness in noise reduction. Nozzles with different exit spacings are tested. It is found that the multiple-jet design significantly decreases noise levels in the audible range by shifting emitted sound power to higher and ultrasonic frequencies. No significant difference in noise characteristics between exits distributed on a flat plane and beveled exits on a conical surface is observed. When the exits are more densely distributed, there is a trend of spectra shifting back toward the low frequency. This phenomenon is found to increase sound levels in a certain range of frequencies much lower than the peak one. Although this increase contributes little to the total emitted sound power, it is an important factor in determining the sound levels of audible noise.

Marek L. Szary, Yoginder P. Chugh, Joseph Hirschi. *Noise Variability in Underground Room and Pillar Coal Mines*. S. 301-308.

Noise in an underground coal mine has dominant components generated mainly from 3 sources: (a) continuous mining machines, (b) roof bolters, and (c) cars/vehicles used to transport personnel and/or coal. Each of these 3 noise sources also has a number of well-defined sub-sources with their own noise characteristics. Sound level meters were used to collect noise data in the form of instantaneous readings and also to check calibration of other sound measuring instruments. The most useful information was obtained from a spectrum analysis of continuous digital recordings of noise over time. This paper discusses the variability or dynamics of generated noise in both frequency and time domains in relation to several independent variables related to coal extraction and transportation processes.

Małgorzata Szwarc, Bożena Kostek, Józef Kotus, Maciej Szczodrak, Andrzej Czyżewski. Problems *of Railway Noise : a Case Study*. S. 309-325.

Under Directive 2002/49/EC relating to the assessment and management of environmental noise, all European countries are obliged to model their environmental noise levels in heavily populated areas. Some countries have their own national method, to predict noise but most have not created one yet. The recommendation for countries that do not have their own model is to use an interim method. The Dutch SRM II scheme is suggested for railways. In addition to the Dutch model, this paper describes and discusses 3 other national methods. Moreover, discrepancies between the HARMONOISE and IMAGINE projects are analysed. The results of rail traffic noise measurements are compared with national methods.