THE CHAIR OF MECHANICS AND VIBROACOUSTICS TODAY AND TOMORROW

On 6–7 November 2010, the Seminar "The Chair of Mechanics and Vibroacoustics today and tomorrow" was organized under the patronage of the Head of the Chair of Mechanics and Vibroacoustics, Professor Wojciech Batko and the Deputy--Dean of the Faculty of Mechanical Engineering and Robotics, Associate Professor Jerzy Wiciak.

DISTINGUISHED GUESTS AT THE CONFERENCE:
Professor Janusz Kowal – the Dean of the Faculty of Mechanical Engineering and Robotics
Mr. Andrzej Mikulski – the Mayor of the City of Ogrodzieniec
Mr. Krzysztof Pierzchała – CEO of SIGNALCO Ltd.

THE HONORARY COMMITTEE:
Professor Zbigniew Engel Dr h.c. mult.
Professor Jan Adamczyk D.Sc.

THE SCIENTIFIC COMMITTEE:

Chairman:
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Associate Professor Piotr Kleczkowski D.Sc.
Associate Professor Piotr Krzyworzeka D.Sc.
Professor Jerzy Michalczyk D.Sc.

The seminar was dedicated to the role of the Chair of Mechanics and Vibroacoustics in modern science in the light of changes occurring in higher education. The main issues that were raised included assessment of current achievements and determining of the directions of development for the future. Also, current scientific projects and didactic issues as well as development of international cooperation and means of acquiring financial resources were discussed.

A brief report concerning the current scientific projects executed by the Chair is shown below.

LABORATORY EQUIPMENT FOR THE STUDY OF SOUND DIFFUSSION SYSTEMS

Author: Tadeusz Kamisiński

Considering the development of methods for sound propagation prediction and the technologies for production of acoustic systems, the role of experimental data on sound scattering properties of materials is gaining importance. Due to the level of difficulty of conducting this type of research and the high cost of the laboratory equipment, only few acoustic research laboratories in the world specialise in such studies. For several years measurement setups have been built and research procedures have been developed at the Technical Acoustics Laboratory of the Chair of Mechanics and Vibroacoustics at the AGH University of Science and Technology in Krakow. The purpose of this research is to obtain and use measurement data for technical solutions involving acoustical upgrade of interiors or the manufacture of noise barriers. A prototype measurement set-up was built under ordered research project No. PW-004/ITE/10/2006 *Measurement manipulator system for laboratory vibroacoustic measurements* This set-up is currently used to determine the sound diffusion coefficient *d* of various materials in the anechoic chamber.

This area of research is currently continued under Development Project No. N R03 0036 06 *Measurement set-up and procedures for studies of sound diffusion systems*. Under

this project a special measurement set-up was built in the anechoic chamber comprising a turntable integrated with a measurement system for determining the sound scattering coefficient *s*. At the same time another project was implemented: project No. UDA-POIG.01.04.00-04-003/09-00 *Designing, studying and launching the manufacture of noise barriers by Moller Polska Sp. z o.o.*, whose final product is a sound diffuser. The project employs the laboratory measurement systems for comprehensive study of acoustic properties of various samples made of wood, and subsequently of the final product manufactured of PVC and sawdust using the extrusion technology. A test sound barrier built of 4.5 m high panels was also tested *in situ* showing high efficiency of screening. Considering the high demand for new acoustic systems employing sound diffusion, our researchers have made considerable effort to develop this area: this includes teaching, theoretical studies, developing laboratory equipment, and application projects.

NOISE MONITORING SYSTEM WITH SOUND SOURCES DETECTION

Author: Jacek Wierzbicki

In all Member States of the ***European Union*** every five years strategic noise maps showing the situation in the preceding calendar year should be made and, where relevant, approved by the competent authorities for all agglomerations with more than 100 000 inhabitants and for all major roads which have more than three million vehicle passages a year, major railways which have more than 30 000 train passages per year and major airports within their territories. The European Commission's advisory group on environmental noise recommended that Member States use computer modeling rather than measurements. But before implementation of the recommended Harmonoise/Imagine P2P algorithms there are noticeable differences in the results calculated by different software packages. The most important question connected with noise mapping executed with the help of computational methods is that concerning reliability of results. Verification of a calculated map requires many measurements to be taken over long periods. In most cases, the noise at a location is produced by a combination of different sources not all of which are required by the regulations to be included. A monitoring system with continuous multimedia (audio, video, meteorological) data recording and with sound sources detection is the subject of investigations. The detection of 3D sound direction as data pre-selection is used in automation of noise sources identification process. The idea of such system and the first results are presented in the paper.

This study is a part of the research project N R03 0030 06 supported by The National Centre for Research and Development NCBiR

THE DEVELOPMENT OF METHOD FOR DETERMINATION OF HAZARDOUS AND PARTICULARLY IMPORTANT AREAS IN LARGE URBAN AGGLOMERATION FOR THE BLIND PEOPLE USING WAVE-VIBRATION MARKERS

Authors: Jerzy Wiciak, Dorota Młynarczyk, Roman Trojanowski

The speech presented the progress of the research project that aims at the development of methods for determination of hazardous and particularly important areas in the big city for the blind people using wave-vibration markers. The first year of the research comprised collecting of information about problems that visually impaired people have while moving around urban agglomerations, and an analysis of possibilities of using wave-vibration signals to help them detect hazardous areas. For this a survey was developed with the help of experienced spatial orientation teachers and carried out among pupils, graduates and teachers of the Institutes for the Blind and Partially Sighted in Cracow and Owińska near Poznan. A total of 248 questionnaires came back. The data obtained from the questionnaires was statistically analyzed in terms of identification and classification of hazardous and particularly important areas in large cities for visually impaired people. Simultaneously, the existing solutions used to help in spatial orientation and wireless data transmission (GPS, IrDA, Bluetooth, RFID and induction loops) were being tested for potential use in the developed system. It was decided that induction loops would be used for the prototype. Plans for further stages of the research consist of: conducting of tests of wave-vibration signals using palestesiometer, building of a prototype device that uses vibration for aiding spatial orientation of visually impaired people and development as well as verification of a method of spatial orientation teaching based on the constructed device.

This study is a part of the research project NR17001706 supported by The National Centre for Research and Development NCBiR.

THE TECHNOLOGY OF SELECTIVE MIXING OF SOUNDS

Author: Piotr Kleczkowski, presented at the seminar by Marek Pluta

The underlying idea for this research is that the segregation of sounds becomes difficult for the ear when it is loaded with too much information. The work is concerned with the following concept: given multiple acoustic sources, excessive information is removed in time-frequency regions where contributions from sources overlap, with the purpose that the remaining information from all sources is segregated more effectively. The basic type of processing is performed by converting individual time signals into time-frequency domain and then performing the comparison of energy of all signals in all time-frequency cells. In each cell, the strongest signal is passed to the final mix of the sounds, the others are discarded. This type of processing results in complete removal of spectral overlap between individual acoustic sources. Experiments demonstrated that the removal of large parts of signals of musical instruments in time-frequency domain may not be perceived in the mix at all. Under certain conditions, some listeners chose impoverished versions as subjectively preferable. These findings were confirmed in an experiment where the same processing was applied to individual speech signals. The target speech tract was slightly more intelligible in the processed mix than in the original one. The purpose of the grant is to find optimal parameters of this type of processing. The most important parameters to look for are the sizes of time-frequency regions and various rules for assigning priority do elements of sounds, depending on the context. Possible applications include mixing of multi-instrumental music or film post-processing.

National Centre for Research and Development project no. Nr R02 0030 06

THE PORTABLE SYSTEM EMPLOYING DUTY CYCLE SYNCHRONIZED METHODS FOR DIAGNOSING THE ROTATING MACHINERY

Authors: Witold Cioch, Sławomir Bieniasz, Piotr Krzyworzeka, Ernest Jamro, Wielgosz Maciej

This paper presents the portable system which is to be used for diagnosing rotating machinery in changing working conditions. It is composed of the three main parts: the card with analog-to-digital converters, FPGA and ARM module which process the acquired data. Due to its modularity, the system can be easily extended and adopted to a machinery being monitored. The presented system is also capable of working in a real-time mode due to its high processing data rate resulting from the adopted architecture and employed high-performance components. A number of the original algorithms have been implemented in the FPGA such as the procedure of linear decimation synchronized with a duty cycle, all of those can be used for non-stationary signals analysis. Furthermore, numerical procedures which do not fit into the FPGA due to the high resources occupation have been employed on the ARM processor. It is worth mentioning that the whole system is run under the Ubuntu system which provides a huge flexibility in a number of software packets available as well as stability of the system as such.

This study is a part of the research project N R03 0061 06 supported by The National Centre for Research and Development NCBiR