

ABSTRACTS OF SOME DOCTORAL DISSERTATIONS IN POLAND

The characteristic elements of the sea noise in the South Baltic**Zygmunt Klusek**

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The basic properties of the sea noise in the South Baltic have been discussed: the spectral density, the statistical characteristics, the directivity, and the dependence on the wind. The theoretical model of the anisotropy of the noise field in the South Baltic has been developed. It has been found that the sea noise level in the Baltic is higher than in the ocean at the same wind velocity. In the author's opinion the acoustical properties of the bottom, the traffic of ships and the large amount of gas bubbles are responsible for this increase. In the spectrum of the sea noise (80-10 000 Hz) there are two main components: one, which is independent on the meteorological circumstances and the other one, which is dependent on the wind velocity. The distribution of the probability density of the sea noise often differs from the normal distribution (in 30-50% of cases) and depends on the place of the measurements and the frequency.

This thesis was distinguished for its high level by the Scientific Council of the Institute of Geophysics of the Polish Academy of Sciences.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.

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The influence of the sea surface and the bottom on the sound propagation in the shallow sea
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The statistical characteristics of the acoustical signals (2-10 kHz) scattered on the rough surface have been experimentally measured in the Baltic (shallow sea) and in the Atlantic (deep sea). It has been found that the normal distribution of the height of sea waves and the scattered acoustical signals is satisfied in the deep sea but not in the shallow one. In the coastal zone the third and the fourth statistical moments of the described parameters must be taken into account and the normal distribution expanded into the Gram-Charlier series gives a good approximation for the distribution of the heights and the scattered acoustical signals. The coefficient of the sound reflection from the selected sediments of the Baltic sea has been measured by the interference method. The measurements have been performed in situ at frequencies from 2 to 10 kHz at normal incidence of the acoustic waves on the sea bottom. The theoretical model of the sound propagation with many reflections from the sea surface and the bottom has been discussed. The autocorrelation function of the scattered acoustical signals has been calculated as a function of the real distribution of the heights of surface waves and the coefficient of the bottom reflection.

This thesis was distinguished for its high level by the Scientific Council of the Institute of Geophysics of the Polish Academy of Sciences.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.
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Nonlinear effects in ultrasonic-laser light-diffraction

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The aim of this paper was the experimental verification of the diffraction theory of high intensity laser beams on ultrasound propagating in liquids of nonlinear optical properties. This theory was developed by JÓZEFOWSKA, ŚLIWIŃSKI and the author of this paper. The experimental setup was designed and built. Some interesting problems were encountered in the design and construction of the experimental apparatus. The results which were obtained confirmed the theory under investigation, although the quantitative relations did not agree with predicted values. In addition to effects predicted theoretically a new effect was observed, i.e. selective extinction of light beams in the first orders of diffraction patterns. An attempt was made to explain this phenomenon.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.
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An analysis of pulsed ultrasonic transmit-receive systems for medical diagnostics

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The paper presents a method for the calculation of the shape and size of pulses radiated and received by ultrasonic transmitting-receiving systems used in medical diagnostics. Using an equivalent electrical circuit for the transducer, the transfer functions for different working conditions of the transducer were calculated and, on the basis of these functions, the acoustical and electrical behaviour was calculated. By means of Laplace transformation output signals were computed for simple cases of open and shortcircuited electrical transducer terminals. Because of the complicated nature of the mathematical relations, a continuous Fourier transform (CFT) was used to describe the systems. This was then replaced by a discrete Fourier transform (DFT), thus preparing the relations for numerical calculations. The DFT was in turn calculated using the fast Fourier transform (FFT). Calculations were made for a number of practical cases. The paper also gives the results obtained from an analysis of the operation of a transmitting transducer for different types of acoustic matching, for a wedged transducer, and for a divided one.

This work was made possible by a grant from Polish Academy of Sciences, Institute of Fundamental Technological Research, Warsaw.

Under supervision of Prof. Dr. L. FILIPCZYŃSKI.
October 1978

Optical holographic method used in investigation of ultrasonic fields

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The aim of this paper was to describe theoretically and to verify experimentally the process of registration and reconstruction of holograms of ultrasonic fields. Three basic techniques used in optical holography, pulse double-exposed, average in time and real

time, were considered. Experimental results obtained confirmed this theory. The experimental setup for investigation of ultrasonic fields was designed and the data obtained were computed by computer. This thesis was distinguished for its high level by the Council of the Faculty of Mathematics, Physics and Chemistry, University of Gdańsk and rewarded a prize by the Minister of Science, High Education and Technology.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.

June 1979

Acoustical relaxation in organic liquids of cyclic structure

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Propagation of ultra- and hypersonic waves in organic cyclic liquids was investigated. The aim of this paper was to find compounds where acoustic Kneser relaxation occurs and to describe the relation between ultrasonic absorption caused by this process and molecular structure. On the basis of measurements and published standards of ultrasonic absorption for cyclic liquids some relations between $(a/f^2)_{\text{rel}}$ and molecular structure were established. Acoustic Kneser dispersion could be observed in five compounds among 23 liquids examined. It was determined which internal vibrational degree of freedom took part in the process observed for two compounds.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.

June 1979

Holography — interferometric examination of vibrations of ultrasonic transducers radiating into liquids

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The aim of this study was to develop a suitable holographic method for detecting vibration amplitudes of ultrasonic transducers of the order of 10^{-9}m . A theoretical and experimental analysis of the holographic interferometry was performed. The optical holography with the phase modulated reference beam was chosen as the only suitable method for visualization and quantitative examination of the vibration amplitude distributions of the ultrasonic transducers of the frequency 0.5-3 MHz radiating into a liquid. A progressive ultrasonic wave propagated in a transparent medium as an optical modulator with an optical filtering was used. The smallest value of the absolute amplitude detected with the procedure was of the order of 10^{-9}m . The vibration amplitude distribution throughout the surface of the transducers for various supplying and fixing conditions were presented.

This thesis was distinguished for its high level by the Council of the Faculty of Mathematics, Physics and Chemistry, University of Gdańsk and awarded a prize by the Minister of Science, High Education and Technology.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.

October 1979

Association of imidazole (1,3-diazole) and pyrazole in *p*-xylene examined with molecular acoustics methods

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This paper contains results of examination of association of imidazole and pyrazole (hydrogen bonds) in non-polar solvent (*p*-xylene) and their interpretation based on ultra-

sonic velocity and attenuation of frequency 7.5 MHz for different concentrations 0.0-0.1% and temperatures 288-343 K. It has been shown that imidazole and pyrazole are good model compounds relating to acoustical properties. They increase the sound absorption of *p*-xylene solutions even at very small concentrations to a degree unnoticed so far in the literature. For the interpretation of results the theory of sound absorption applied in chemical reaction kinetics was developed and a comparison between the theory and experiment was performed, giving a good agreement. Different quantities which determine states of association of imidazole for different concentrations and temperatures were obtained.

Under supervision of Prof. Dr. A. ŚLIWIŃSKI.

October 1979

Impedance of the unbaffled semi-infinite cylindrical wave-guide

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The paper presents the phenomena occurring at the open end of a rigid wave-guide, assuming that only one of the allowed Bessel modes propagates towards the end. The solution of the wave equation at the suitable boundary conditions formulated by Wainstein shows that because of diffraction at the open end part of the wave energy is radiated outside and the remainder returns to the waveguide as a sum of the Bessel modes. In the paper the exact formulae of reflection and transformation coefficients as well as the outlet impedance for any order of incident wave are developed. The numerical calculations of moduli and the phases of reflection and transformation coefficients and also the real and imaginary part of impedance were made for the first six Bessel modes (including a plane wave) for a diffraction parameter in the range 0-20. Analysis of results obtained leads to the conclusion that the impedance of the outlet varies considerably for the different modes propagating towards the open end. Because of it the plane wave approximation, which is generally used, can lead to great errors in such a case when the participation of higher modes in the incident wave cannot be neglected.

Under supervision of Prof. Dr. Roman WYRZYKOWSKI.

April 1980

Influence of crossover network and lay-out of loudspeakers in loudspeaker enclosure on the listening area

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The aim of this work is to find the listening area of a loudspeaker system, where the signal distortions occurring off the main axis of the system are not noticeable to the listener and to maximize this area. For these purposes the sound radiation by loud speaker systems was analysed in the context of a sort of the crossover network and the lay-out of loudspeakers on the cabinet front panel. Equations for directivity patterns of two-way loudspeaker systems with Butterworth filters in a crossover network were analysed. Power frequency response of the system was examined theoretically and experimentally. Formulae for intensity lateralization cues depending on the configuration of loudspeakers in both the enclosures belonging to a stereophonic sound system were obtained. The mathematical description of sound radiation by loudspeaker systems was used for the planning of psychoacoustic measurements. Psychometric curves of discriminability of the linear distortions versus time delay between signals coming to a listener from a woofer and a tweeter were measured. The measurements

of intensity localization cues of stereophonic loudspeaker systems confirmed adequacy of the theoretical formulae. Knowing the type of a crossover network we can show a loudspeaker configuration which gives maximum spatial stability of sound images during the listening point displacement. Results of the theoretical considerations and the psychoacoustic measurements can be applied in the designing of the optimal lay-out of loudspeakers in monophonic and stereophonic systems. They allow us to determine the admissible mutual loudspeaker displacement on the front panel of a loudspeaker enclosure and in the depth of an enclosure.

Under supervision of Associate Prof. Janusz RENOWSKI.

February 1980

Application of linear prediction methods to linear system identification

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In the dissertation the problem of linear system identification in the presence of disturbing quantization noise by means of linear predictive methods has been investigated. Among the three classical algorithms realizing linear prediction method, i.e. the Shanks, Steiglitz-McBride and Kalman algorithms, according to a reasonable assumption the last method has been chosen for further investigation. On the basis of the theoretical analysis of the problem and the results of experimental investigation, a criterion of choice of the quasioptimal model transfer function form $H(z)$, without disturbing noise, has been formulated. In the further part of the dissertation the estimation of the error of determination of coefficients of the model transfer function form $H(z)$ for disturbing noise, introduced by symmetrical quantizer, was derived, and the conception of a modified system of linear system identification based on the Kalman and Steiglitz-McBride methods was given. In the modified algorithm the failures of the applied methods were eliminated and their advantages used. In the modification the solution obtained by the Kalman method was treated as the exact one, and subsequently one iteration according to the Steiglitz-McBride algorithm was made. The criterion of choice of the quasioptimal solution in the linear system identification procedure has been formulated, i.e. quasioptimal form of the transfer function of the model of linear system identified, limiting our considerations to the case of identification in the presence of equidistant quantization noise, has been given. The threshold values of estimation of the error of identification of coefficients of the transfer function of systems investigated as well as the threshold values of energetic error have been given as a function of the number of bits. A series of experiments on the identification of a certain class of linear system has been carried out. In the dissertation the postulate of determination of the optimum criterion of choice of the model transfer function was neglected, and the quasioptimal criterion was used instead, thus simplifying greatly the method of determination of the choice solution indices. The results obtained in the experiments suggest the possibility of a practical application of the method to the identification of a wide class of minimumphase linear systems excited by a unit impulse or minimumphase signals.

Under supervision of Associate Prof. Janusz ZALEWSKI.

March 1980

Analysis of frequency changes of transient state of sound propagating in a room

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The work comprises an analysis of the effect of momentary frequency changes of sound during its growth and decay process, depending on a series of selected acoustic parameters

of the enclosure. Results indicate that momentary frequency changes of the transient state of sound propagating in a room have a character of smaller or larger fluctuations around a steady frequency value, and that the fluctuations for a specified direction of frequency changes can be relatively prolonged. The magnitude of momentary frequency changes depends on the growth or decay considered, on the time fragment of the investigated process, on the duration of sound sent to the enclosure, and on its frequency range. On the other hand, a strong dependence of the momentary frequency changes on the frequency response of the room, on the location of the measuring point, and to some extent on the reverberation conditions of the room has been observed. The work emphasizes the need for a psychoacoustic verification of the perception of the momentary frequency changes in sound, essential in the problem of the subjective evaluation of the room acoustic properties.

Under supervision of Associate Prof. Edward OZIMEK.

January 1981

THE SUMMER WORKSHOP ON THE IDENTIFICATION OF SOUND SOURCES AND THEIR PROPAGATION PATHS JABLONNA 6-11 JULY, 1981

The Summer Workshop on the Identification of Sound Sources and their Propagation Paths was held at Jablonna on 6-11 July, 1981.

This Workshop was organized by the Committee on Acoustics of the Polish Academy of Sciences and Polish Acoustical Society in cooperation with the Institute of Fundamental Technological Research of the Polish Academy of Sciences and the Institute of Mechanics and Vibroacoustics of the Academy of Mining and Metallurgy, Cracow. The Workshop was sponsored by the International Institute of Noise Control Engineering. Prof. Stefan Czarnecki was the Chairman of the Workshop.

50 participants, including 20 foreigners from 10 countries, took part. Eleven two-hour lectures were delivered, eight of which were delivered by the foreign guests and three by Polish scholars. Each lecture was followed by round-table discussions.

The lectures and discussions were divided into the following sections:

- I. Components of a single sound source — experimental methods.
- II. Components of a single sound source — practical results.
- III. Many sources — theory and calculation methods.
- IV. Many sources — experimental methods.
- V. Many sources — measurement techniques.
- VI. Many sources — practical results.
- VII. Sound paths — experimental methods.

Ewa Kotarbińska (Warsaw)

THE JOURNAL OF THE ACOUSTICAL SOCIETY OF JAPAN (E)

With real satisfaction we welcome the English version of periodical of the Acoustical Society of Japan, The Journal of the Acoustical Society of Japan (E).

Many of the papers in this periodical, which has appeared essentially in the Japanese language for many years, have been published in English. In addition the Editors have done much to bring the other papers closer to the international scientific community

by publishing their abstracts, figure and table legends etc. in English. All these efforts have contributed to establishing a very good opinion of the investigations of Japanese acousticians and their Journal in the scientific world.

Nevertheless, in many cases, the language barrier has caused the periodical to contribute only partially to the international exchange of scientific information. This incomplete share of Japanese acousticians in this exchange was also felt by the Acoustical Society of Japan which, after analysis of the situation, decided to publish an English version of the journal of the Society each quarter of the year and to invite scientists in other countries to submit their papers to it, which will doubtless give the periodical a more international character.

Archives of Acoustics wishes every success to the Editorial Committee of the Journal of the Acoustical Society of Japan.

R. Gubrynowicz

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