

Acoustic and Biomedical Engineering  
2014

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POLISH ACADEMY OF SCIENCES  
INSTITUTE OF PHYSICS

This issue of *Acta Physica Polonica A* is dedicated to the Memory of the late Professor Zbigniew Engel.

Papers collected in this issue deal with sound, vibrations, and the impact of these physical phenomena on humans and the environment — the subject matter so close to the Professor.

The issue opens with a short *In Memoriam* note about life and work of this distinguished academic, one of Poland's most prominent specialists in mechanics and acoustics, who has rendered so great service to development of vibroacoustics as a sovereign scientific discipline. Subsequent papers present achievements of scientists from such research centres as Kraków, Poznań, Bydgoszcz, Lublin, Olsztyn, Rzeszów, Szczecin, and Warszawa. The range of topics encompasses a wide selection of issues related to impact of vibroacoustic factors on humans and the natural environment, propagation and identification of acoustic waves, and problems related to generation, propagation, and suppression of vibrations.

The current issue has been edited and prepared for print as a result of co-operation between Kraków Division of the Polish Acoustical Society and the Department of Mechanics and Vibroacoustics, Faculty of Mechanical Engineering and Robotics of the AGH University of Science and Technology in Krakow.

## Professor Zbigniew Engel (1933-2013)

### *In Memoriam*

Professor Dr. Hab. Eng. Dr. H.C. mult. Zbigniew ENGEL, one of Poland's most eminent scientists in the field of mechanics and acoustics, co-originator of vibroacoustics as a new research discipline, great Scholar and Master for many of us, has passed away on November 2, 2013.

Born on April 1, 1933 in Zawady, Lviv Voivodeship (now in Ukraine), Zbigniew Engel was a pupil of the Jan Matejko Gymnasium and Secondary School in Wieliczka and next a graduate of the Faculty of Communication of AGH Polytechnic Faculties (Krakow University of Technology). He started his scientific and teaching activity in 1952 as a deputy assistant in the Department of Technical Mechanics of the then Academy of Mining and Metallurgy. In 1962, The Board of the Faculty of Mining and Metallurgical Machines conferred him the degree of Doctor in Technical Sciences, and later, in 1966, the degree of Doctor Habilitatus. In the year 1973, Dr. Hab. Zbigniew Engel was conferred the scientific title of the Assistant Professor, and shortly after that, in 1978, he was nominated Full Professor.

Professor Engel was an author or co-author of more than 600 scientific and technical publications, including 30 monographs and textbooks, university course books, papers presented at scientific conferences and congresses, and a dozen or so patented inventions. His creative achievements concerned such issues as dynamics of machines, mechanical vibrations, vibration technique, environmental acoustics and the related solutions applicable to noise and vibration abatement, vibroacoustic diagnostics, and methods of active vibration and sound control.

Extensiveness of problems being identified and undertaken by the Professor in the above-mentioned wide area of His interest gave rise to origination of a new scientific discipline — the vibroacoustics — a science combining achievements of the theory of vibration of mechanical systems with the edifice of contemporary acoustics thus allowing to provide coupled vibro-acoustic models of actual vibration and sound generating structures. Professor Engel has formulated basic problems of this new discipline, delineated its specific field of research, and defined its fundamental objectives. The issues pointed out by the Professor as the domain of that branch of science included identification of vibroacoustic energy sources, examination of paths on which such energy is transmitted and analysis of ways in which it is transformed, using vibroacoustic processes to diagnose technical condition of machines, devices, structures, or monitored dynamical processes, applying vibroacoustic processes to realise specific technological processes, carrying out vibroacoustic synthesis of machines, devices, and technical facilities, controlling vibroacoustic energy flows, and developing active vibration and noise reduction systems.

Professor Engel was also the leader of a group of initiators who aspired to develop the research on active noise and vibration control in Poland and a pioneer in the area of the theory and practice of inverse problems in acoustics. He has formulated the vibroacoustic rule of reciprocity. In His works, Professor used to underline the need to develop this very approach in modelling vibroacoustic processes and emphasise its strong links with the problems concerning identification of acoustic parameters of machines as well as acoustic properties of interiors.

Professor Zbigniew Engel maintained extensive contacts with academics from scientific centres scattered all over the world, of which, as an example, one can mention the Purdue University, Lafayette, USA; the Technical University of Denmark, Lyngby, Denmark; the Technical University of Munich, Germany; the Slovak University of Technology in Bratislava, Slovakia; the Institute of Materials and Machine Mechanics, the Slovak Academy of Sciences in Bratislava; the Technical University Dresden, Germany; the Institute of Machine Construction of the Russian Academy of Sciences in Moscow; the Technical University of Tokyo, Japan, and the Department of Acoustic, Polytechnic Institute in Kiev, Ukraine.

Apart from scientific work, another life's passion of the late Professor Engel was teaching, working with students, and training young research personnel. On one hand, He was an exacting teacher and examiner for students and a



demanding superior and thesis' supervisor for the scientific staff members; on the other, the Professor was always available to them for consultation, advice, or just friendly conversation. He has considered these talks as an important component of the didactic technique within the framework of the Master-disciple formula. Under His supervision, more than 200 diploma, engineer's degree, and MSc degree dissertations have been written and successfully defended. Professor Engel was elected The Best Lecturer by students for whom he has conducted a cycle of lectures on Technical Mechanics. His achievements in the area of development of the research personnel were equally impressive: He has promoted 40 Doctors of Science, many of whom were later granted the degree of the Doctor Habilitatus or conferred the official academic title of Professor.

Professor Zbigniew Engel performed a number of responsible functions at His parent University. As the AGH Rector's Plenipotentiary for Organisation of the University Consultation Centre in Kielce, He was among those who strove for establishment of local Engineering College, transformed later into the Kielce University of Technology. At AGH, Professor Engel was a founder, and then for many years the Director of the Institute, currently named the Department of Mechanics and Vibroacoustics. As the member of the AGH senate for many terms, he chaired several Senate Committees appointed to carry out organisational reforms at the University.

The Krakow scientific circle connected with the Faculty of Mechanical Engineering and Robotics of the AGH University of Science and Technology owes a lot to the late Professor Zbigniew Engel. First of all, it is necessary to mention at this point His extraordinary commitment to creation of scientific, research, and teaching base for vibroacoustics in the then Academy of Mining and Metallurgy (AGH). Professor Engel was an initiator and active organiser in the early stage of planning and creating AGH vibroacoustic laboratories, including erection of the new Vibroacoustics Building. As a result of His persistent endeavours and effective actions, Krakow as a scientific centre has been expanded by world-class laboratories furnished with up-to-date measuring equipment and such indispensable facilities as Poland largest free-field room and equally imposing reverberation chamber.

Another impressively extensive area of Professor Engel's service was his activity in the field of noise and vibration control in the framework of numerous international organisations. He was a member of committees preparing drafts of such legal instruments as acts of law, executive regulations, standards, etc., seeing always to it that such proposals result in consistency of rules applicable in Poland to noise and vibration control with those adopted elsewhere in the world, especially in the European Union. He organised scientific seminars devoted to noise abatement. Professor Zbigniew Engel played also an active role in work of the International Institute for Noise Control Engineering (I-INCE), was a Member of the Institute Board of Directors, and took part in many undertakings sponsored by the organisation. He was also a many-time Member of the Scientific Committee of the International Congress on Noise Control Engineering INTER NOISE.

Thanks to His unique activeness, Professor Engel has gained considerable standing and exceptional authority in the scientific community, in recognition of which he was conferred the rank of the Honorary Member of the Polish Acoustical Society, the League for Fight Against Noise, the East European Acoustical Association in St. Petersburg, and the Association of Academics and Engineers in Moscow. He was the President of the Committee on Acoustics of the Polish Academy of Sciences and the Vice President of Polish Central Council for Science and Higher Education. For many years, he was also the President of the Committee for Applied Mechanics of the Krakow Division of the Polish Academy of Sciences.

For outstanding contribution to the development of mechanics, Senates of the Academy of Mining and Metallurgy, the Krakow University of Technology, and the Kielce University of Technology have honoured Professor Zbigniew Engel with their Honoris Causa Doctorates. He was also conferred the rank of the Honorary Professor of the Warsaw University of Technology.

Professor Engel's scientific, organisational, and teaching activities were rewarded with numerous prizes, decorations, and distinctions. From among domestic and foreign decorations one should mention the František Křižík Gold Medal awarded by the Czech Academy of Sciences, Hungary's Pro Silentia Medal, and high state decorations such as the Commodore's Cross, the Officer's Cross, and the Knight's Cross of the Order of Polonia Restituta, the Gold Cross of Merit, and the Medal of the Commission of National Education. Professor Engel was also a laureate of numerous prizes awarded to Him by e.g. the Minister of Science and Higher Education, The Minister of National Education, the Minister of Building Industry, and the Capital Royal City of Krakow in the field of science and technology.

For His inexhaustible vitality, outstanding organisational abilities, and relentless imperative to act, Professor Zbigniew Engel will remain in a fond memory of his friends and collaborators.

Wojciech Batko  
*AGH — University of  
Science and Technology  
April 2014*