



Engineering Power

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CAETS



EDITOR-IN-CHIEF'S WORD

Dear Readers,

It is with great pride and joy that we are able to present you, shortly after this year's first issue of the „*Engineering Power*“, the double issue of our Academy's Bulletin in Croatian and in English, „*Tehnčke znanosti*“ Vol. 21(1) 2017 / „*Engineering Power*“ Vol. 12(2) 2017.

This issue is prepared in co-operation of the Guest-Editor Mario Cifrek, Associate Member of the Academy, with his colleagues and co-workers from the Faculty of Electrical Engineering and Computing in Zagreb and the University Hospital Centre Zagreb. The issue is dedicated to selected current research projects in neurophysiology,

which address brain electrical signals i.e. their measurement, processing, analysis, and application.

As a scientific organisation dedicated to promotion and popularisation of technological and biotechnological sciences, facilitating continuous cooperation of our most prominent scientists as well as strengthening the public awareness of the importance of technological and biotechnological sciences, our Academy consistently and tirelessly strives to bring to our readers from all fields and professions the most important and valuable insights into our members' activities, and into the state of individual domains in technological and biotechnological sciences.

Editor-in-Chief

Vladimir Andročec, President of the Croatian Academy of Engineering



EDITOR'S WORD

Mutual permeation of engineering sciences and contemporary medical practice is one of the best examples of the necessity of multi-disciplinary approach in present-day science. From computer modelling and numerical simulations of physical and chemical processes within the biological systems, and utilisation of instrumentarium based on more and more sophisticated technological solutions for diagnostical purposes, to intelligent orthopedic apparatuses and smart prosthetics („*wearable robotics*“), the application of advanced engineering solutions has been inevitable in almost all domains of the contemporary medicine.

The awareness of the necessity of such interconnection is reflected in the everyday activities of the Croatian Academy of Engineering, which closely co-operates with the Croatian Academy of Medical Sciences and clinical and research institutions within the frame of work on joint projects, the organisation of scientific conferences, and other socially important activities.

Having in mind all aforementioned, I am especially pleased to present you this issue of the „*Engineering Power*“, which addresses a subject that interconnects the domains of engineering activities and medical practice in a particularly relevant manner. The Guest-Editor of this issue is Mario Cifrek, Associate Member of the Croatian Academy of Engineering in the Department of Systems and Cybernetics, and Full Professor at the Faculty of Electrical Engineering and Computing of the University of Zagreb.

Editor

Zdravko Terze, Vice-President of the Croatian Academy of Engineering



GUEST-EDITOR'S WORD

Brain electrical signals – measurement, processing, analysis, and applications

Biomedical engineering is an interdisciplinary field combining knowledge of engineering (electrical engineering, computer science, information and communication technology, physics, chemistry ...), biology and medicine. The development of medical science, health service organisation and health care at the turn of this century is closely and inseparably linked to the development of electronic, computer, information and communication technologies. Electrical equipment and accessories are an integral part of almost every medical examination/intervention, and computer and information and communication systems are now an inseparable part of everyday life.

Electroencephalography (EEG) is one of the basic neurophysiological methods of registration of the brain bioelectric activity. It was first mentioned in the thirties of the last century in the works of neuropsychiatrist Hans Berger. He was recording, using sensitive galvanometer, the first signals that belong to the alpha frequency range, according to today's classification. EEG as a diagnostic method begins routinely carried out with the first commercially available electroencephalograph in the fifties of the last century. Here we must point out Professor Ante Šantić who already in 1957, as an employee of the Institute of Electrical Engineering in Zagreb, designed and commercialised 12 channel electroencephalograph, the first in South-eastern/Central Europe. Upon arrival at the Faculty of Electrical Engineering, University of Zagreb, in 1972 he founded the Laboratory for Biomedical Electronics and starts lecturing on Biomedical Electronics, for which he wrote the textbook of the same name, and thus lays the foundation of biomedical engineering in Croatia. Technological progress made it possible to process electroencephalographic signals on the digital computer. Already in the beginning of the seventies, it was carried out on the PDP-8 computer by Prof. Stanko Tonković, PhD, Dipl Eng, an employee of the Faculty of Electrical Engineering in Zagreb, and Velimir Išgum, PhD, Dipl Eng, an employee of the Clinical Hospital Centre Zagreb. Velimir Išgum, PhD, continues his career in the Department of Neurology, University Hospital Centre Zagreb, where he participated in the founding of the Laboratory of evoked potentials. Additionally, he founded the Laboratory for Cognitive and Experimental Neurophysiology. Several papers listed thereafter represent a continuation of research that started in these laboratories.

Initiation and development of this inter- and multi-disciplinary area would be impossible without the support and active participation of medical doctors. This high quality and fruitful collaboration took place to this day, which is directly visible in the presented papers.

The following papers presented some of the current research projects in the field of neurophysiology that uses measurement, processing and analysis of the electroencephalographic signals. The first paper presents several modalities for brain-computer interface (BCI), very actively investigated area in the last years. The following paper deals with the application of invasive EEG monitoring in the surgical treatment of patients with pharmacoresistant epilepsy. The third document describes the use of the evoked potentials in the diagnosis of multiple sclerosis. The fourth paper describes the diagnostic value of vibration evoked potentials, while the fifth one deals with auditory evoked potentials with a focus on the used stimuli and paradigms.

Guest-Editor

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