



Editorial

Guest Editorial introduction to the special issue on Biomedical Signal Processing and Analysis selected papers from ITAB 2009

Recent technological advances in medicine have facilitated the development of complex biomedical systems including sophisticated biomedical signal devices and instruments, medical imaging equipment, and computer-aided diagnosis (CAD) tools enabling the better delivery of healthcare services. These systems are based on advanced biomedical signal and medical imaging processing and analysis techniques that have emerged as promising tools for the development, application, and implementation of intelligent biomedical systems and devices. The impact of these technologies is demonstrated nowadays via the offering of state of the art e-health services.

The aim of this special issue is to provide a snapshot of emerging technologies in biomedical systems and services focused on “Biomedical Signal Processing and Analysis”, based on selected papers presented in the 9th International Special Topic Conference on Information Technology in Biomedicine (ITAB 2009), held in October 2009, in Larnaka, Cyprus (<http://www.cs.ucy.ac.cy/itab2009/>). The event was technically co-sponsored by the IEEE Engineering in Medicine and Biology Society, the University of Cyprus, the Cyprus University of Technology, and the University of Ioannina. A special issue call was announced and 34 papers were received. All the received papers went through the peer review process of the Biomedical Signal Processing and Control journal. From the submitted papers 14 were accepted for publication, organized under the topics of Biomedical Signal Processing and Analysis, and Medical Imaging, with 10 and four papers, respectively. These papers are briefly presented in the following section.

1. Biomedical Signal Processing and Analysis

The paper by Ramamurthy et al. investigated how discrimination of different analytes can be performed by extracting appropriate features from the ion-channel signals and using them for classification. Results obtained show that the transform domain features (Fourier, Wavelet and Walsh-Hadamard domain representations) achieve high classification rates in addition to high sensitivity and specificity rates.

Cesarelli et al. investigated how cardiocographic data can help the physicians in the assessment of fetal development, including the assessment of conditions such as fetal distress.

The Hilbert–Huang Transform (HHT) was studied in the analysis of signals originating from nonlinear processes as well as non-stationary signals in a paper by Karagiannis and Philippou.

The usefulness and adaptive nature of the proposed analysis were demonstrated on ECG signals from the MIT-BIH database.

Krisciukaitis et al. developed a clinical decision support system for the assessment of acute phase of myocardial infarction. The system is based on: (a) chest impedance signal analysis enabling reliable evaluation of central hemodynamics in a non-invasive way, and (b) the automatic detection and evaluation of ECG T-wave. The proposed system improved the quality of monitoring of the patient status in intensive care unit.

Kana and Holcik describe a new mathematical model based on physiology for quantifying cardiovascular control during the Valsalva maneuver. The proposed model supports the quantification of the tone of sympathetic and parasympathetic discharge on the cardiovascular system, and predicts the left ventricle stroke volume change, the baroreceptors firing rate, as well as the duration and strength of each phase of the Valsalva maneuver.

The paper by Katsis et al. presents a system used for monitoring patients with anxiety disorders during therapeutic sessions. It recognizes an individual's affective state based on 5 pre-defined classes (relaxed, neutral, startled, apprehensive and very apprehensive), from physiological data collected via non-invasive technologies. Different classification algorithms were tested in order to evaluate the accuracy of the proposed system.

The paper by Sprdlik et al. investigated the decomposition of acceleration as an alternative to commonly used direct spectral analysis of measured acceleration or angular velocity for tremor quantification. Resulting signals, beside measured acceleration and angular velocity were used to assess tremor amplitude and frequency by spectral peak detection.

Objective measurements of source-to-ear responses obtained in a human echolocation experimental paradigm were documented in the paper by Papadopoulos et al. They identified the auditory cues that allow humans to perform echolocation tasks in the specific scenario studied and discussed the salience of those cues with respect to more complex scenarios.

Klados et al. propose a novel hybrid methodology for automatic electroocular (EOG) artifact rejection. Independent Component Analysis (ICA) was used to decompose EEG signals into spatial independent components (ICs). Then an adaptive filter, based on a stable version of the Recursive Least Square (sRLS) algorithm, was applied to ICs so as to remove only EOG artifacts and maintain the neural signals intact. Results support the argument that REG-ICA removed successfully EOG activity, while it minimizes the distortion of the underlying cerebral activity.

Serbes and Aydin investigated the usefulness of the discrete complex wavelet transform (that is a shift invariant transform with limited redundancy) in the analysis of quadrature Doppler directional flow ultrasound signals. It is demonstrated that the proposed method gave the same output as the conventional technique and the computational complexity for processing quadrature signals using discrete complex wavelet transform was greatly reduced.

2. Medical imaging

Stylianou and co-workers studied the non-linear optical properties of collagen. Collagen is the most abundant protein in mammals and is important for a variety of functions and its concentration, structure and function are associated with different pathological states. In this research collagen structural changes were correlated with changes in the Second Harmonic Generation (SHG) signal, combined with Atomic Force Microscopy (AFM) imaging.

In this work, Dimou et al. evaluate a set of support vector machine classifiers in the task of brain tumor classification based on MRI imaging, and Magnetic Resonance Spectroscopy features. It is documented that the proposed system can provide the human expert with easily interpretable probabilistic metrics to assist in the time, volume and accuracy demanding diagnostic process.

He et al. describe a new mammographic image segmentation based on geometric moments and prior information based on mammographic building blocks (i.e. nodular, linear, homogenous, and radiolucent). The proposed approach is recommended for helping radiologists estimate the risk of breast cancer.

Toumpaniaris et al. propose a new theoretical method for measuring volumes in the right ventricle. The proposed approach is based on the use of an ultrasound transducer mounted on miniature rotating structure that can be used to measure distances to several points on the ventricular wall. A software model is used to simulate measurements and to show that the error can stay within the required volume estimation tolerance of 15%.

Concluding, given the rapidly growing aging population, the increased burden of chronic diseases, the offering of innovative and demanding healthcare services, and the ever increasing healthcare costs, there is a strong and urgent need for the development, implementation, and deployment in everyday medical practice of advanced biosignal processing and analysis, and medical imaging,

systems and services in support of the citizen. This special issue, and future ITAB conferences, aim to contribute to this in both context and direction.

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