Focus Theme – Editorial

This focus theme of Methods of Information in Medicine “Biosignal Interpretation II – Advanced Methods for Studying Biosignals and Images” is a subsequent publication of selected and updated papers presented at the seventh International Workshop on Biosignal Interpretation held on July 2–4, 2012 in Como, Italy. The previous issue of the series “Biosignal Interpretation I” focused on advanced methods for studying cardiovascular and respiratory systems [1].

The International Workshop on Biosignal Interpretation started as a joint initiative of the Medical Informatics Association (IMIA) and the International Federation for Medical and Biological Engineering (IFMBE) in 1993 at the University of Aalborg. The founder, Professor Annelise Rosenfalck, intended to promote communication between biomedical engineering and medical informatics research communities. In order to interpret and effectively utilize the vast amount of biosignal and medical data assessed on a daily basis, the collaboration between these two major medical research fields is gaining importance. Since the third meeting in Chicago in 1999, the IEEE EMB society joined the workshop as a major initiative. Other scientific organizations have supported the program from time to time. The IEEE Italian Chapter on BME, the Italian Bioengineering Group (GNB), the Italian Society of Electrical and Telecommunication Engineering (AEIT), and the Department of Bioengineering of the Politecnico di Milano supported the seventh International Workshop on Biosignal Interpretation out of which this focus theme issue has been realized.

Methods of Information in Medicine has been publishing selected papers presented at the Biosignal Interpretation (BSI) workshop from the first meeting [1–8]. The readers are suggested to review that literature to trace back to the development of the field.

This focus theme issue includes seven papers on neural signals and images (EEG phase coupling, non-linear EEG response analysis, evoked potential space distribution, EMG motor unit tracking, connectivity analysis of fMRI, dynamical fMRI modelling, and remote health care system). The first three papers are on EEG or EMG biosignal analysis. Schiecke et al. [9] compared quadratic phase coupling (QPC) in EEG between premature and full-term newborns. They found that the QPC rhythm around 0.1 Hz is slower and less stable in premature newborns suggesting a continuous development of thalamo-cortical interactions. Melia et al. [10] examined the ERP variation between frequent and infrequent stimuli to observe the adaptation effect for different stimulus modalities. Instantaneous entropy measures derived from the time-frequency distribution of ERP’s are compared. Significant differences are found in the δ band that may be utilized in the characterization of the nociceptive responses. Tahirovic et al. [11] are proposing a new method of estimating spatially distributed P300 evoked potentials based on ICA decomposition. A notable feature of the method is that it is capable of providing appropriate spatial filtering for individual data. Gligorijević et al. [12]
evaluated the robustness of motor unit tracking using high-density surface EMG against changes in the electrode location and orientation. Based on the result, a numerical method to correct displacement errors of the recording signals has been proposed. The method is useful for efficient tracking of specific motor units’ activity over a long period, which has been a difficult task thus far.

The next two papers are on the brain functional connectivity analysis based on fMRI data. Griffanti et al. [13] estimated the random noise level of the fMRI signals that yields the false connection in functional connectivity analysis. They found the inter-subject variability is small, which suggests that the proposed global thresholding method is effective in creating an accurate functional connectivity map. Osorio et al. [14] describe the multiple-model Kalman filtering technique to effectively select connectivity models with hidden states targeting fMRI data modeling. Monte Carlo simulation confirmed the validity of the proposed method.

The last paper is on an e-healthcare system. Colantonio et al. [15] reported a new development of the system for automatic evaluation of data collected by an e-diary card for Chronic Obstructive Pulmonary Disease (COPD) patients. The system will be useful for the remote management of COPD patients.

Two focus themes on BSI presented 15 papers. The BSI workshops, which continue to be held every 3 – 4 years, have been holding the vision to merge the fields of biosignal processing and medical informatics. The guest editors feel that it will be easier to achieve this goal because of the recent remarkable development of information processing methodology for big data analysis, the availability of enhanced computational power with virtually unlimited data storage, and the advancement of miniaturized biosignal acquisition/instrumentation systems. We hope that the BSI focus themes will attract readers’ attention to this emerging field.

References