Biosignal Interpretation I

Advanced Methods for Studying Cardiovascular and Respiratory Systems

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The following two focus themes of *Methods of Information in Medicine* Biosignal Interpretation I: “Advanced Methods for Studying Cardiovascular and Respiratory Systems” and “Biosignal Interpretation II: Advanced Methods for Studying Neural Signals and Images” include selected and updated papers presented at the seventh International Workshop on Biosignal Interpretation held on July 2–4, 2012 in Como, Italy.

The workshop aims at exploring the fields of biosignal interpretation including model based signal analysis, data interpretation and integration, medical decision making extending the existing signal processing methods and technologies for the effective utilization of biosignals in a clinical environment as well as for a deeper understanding of biological functions from the whole organism, system, to cellular, protein and gene scales.

*Methods of Information in Medicine* has a long tradition of publishing selected papers from the BSI workshop. The previous BSI related special issues listed in [1–7] enable readers to follow the footprints and the progressive development of the field. The 7th BSI-workshop has been the joint initiative of the International Medical Informatics Association (IMIA), the International Federation for Medical and Biological Engineering (IFMBE), the IEEE Engineering in Medicine and Biology Society (EMBS), as well as 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.

The first focus theme includes eight papers on cardiovascular and respiratory signals (heart rate variability: analysis, modeling and monitoring, sleep apnea detection, physiological interpretation of arrhythmia, respiratory sound classification and a novel point process nonlinear modeling of cardiovascular and respiratory systems). Fischer et al. [8] applied a bivariate segmented Poincaré plot analysis to blood pressure and beat-to-beat interval series to perform risk stratification of pregnant women suffering from hypertension and pre-eclampsia. Results demonstrate that the proposed method is able to provide a superior classification, distinguishing chronic and gestational hypertension from pre-eclampsia. Sen et al. [9] proposes a novel classification method for the diagnosis of bronchiectasis and interstitial pulmonary disease. Signal parameters derived from 14-channel vector autoregressive model are fed into a support vector machine (SVM) yielded a good classification accuracy. Valenza et al. [10] proposes a Point-Process-based method for discriminating mood states in bipolar patients. The proposed approach is based on a Nonlinear Autoregressive Integrative (NARI) model applied to heart rate variability (HRV) measures. Instantaneous features of HRV in time and frequency domain including higher order statistics are utilized for the successful dynamic state classification between euthymic and depressive phase of bi-
polar patients. Maier et al. [11] are presenting a robust and accurate detection method of the presence of sleep apnea based on Holter ECG recordings. They introduced a novel time-domain feature called the joint local similarity index (LSI) which quantifies the time-locked occurrence of characteristic low-frequency modulations in ECG, respiratory myogram interference, QRS amplitude and the heart rate. Migliorini et al. [12] examined the reliability of piezoelectric sensors integrated into the mattress for the nocturnal heart rate monitoring. They introduced the strength of the cseprum peak value as a new index to evaluate the "confidence" for each extracted heart beat intervals. Comparison of the method with the standard ECG analysis confirmed its high reliability in bed side heart rate monitoring. Berenfeld et al. [13] showed Atrial Fibrillation (AF) patterns recorded from the surface of the sheep heart and interpreted them in terms of transmural patterns. Their method combines endocardial-epicardial optical mapping, phase and spectral analysis and computer simulation of the re-entrant activity in the myocardial wall. The results present basic physiological understanding of the activation patterns during AF. Bueno-Orovio et al. [14] studied the effect of the slow phase of action potential duration (APD) adaptation on dispersion of repolarization and reentry in the human ventricle. A combined analysis of in-vivo human data and computer simulations to examine the contribution of this component to arrhythmogenic in human ventricle is presented. Minchole et al. [15] proposed a method to quantify the time adaptation of Tpeak-to-Tend (Tpe) and QT intervals’ duration after a change in heart rate, in particular, during the head up tilt test. An efficient method to estimate the dynamical nonlinear model parameters are introduced and the evidence that Tpe intervals adapt faster than QT intervals during the tilt experiment has been revealed.

The second focus theme on advanced methods for studying neural signals and images is scheduled to be published in a separate volume. Those two issues will give readers the opportunity to explore the latest development in the field of biosignal interpretation.

References