Otkrivanje znanja i prediktivni modeli u kardiologiji

Knowledge discovery and predictive models in cardiology

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In this communication, we would like to show how the consideration of the temporal dynamics of cardiac features improve interpretation of cardiac multivariate time series. Two different approaches will be described and demonstration will be illustrated over two examples.

The first methodology combines spatiotemporal fuzzy coding and multiple correspondence analysis (MCA). MCA is applied in order to: 1) reduce the dimensionality of the data and provide new synthetic indexes based on the "factorial axes" obtained from MCA; 2) interpret these factorial axes in physiological terms; and 3) analyze the evolution of the patient's status by projecting the acquired data into the plane formed by the first two factorial axes named "factorial plane." As an illustration, data obtained from an implantable device with two sensors (a transthoracic impedance sensor and an accelerometer) are analyzed in order to discover their potential application for the follow-up of patients treated with a cardiac resynchronization therapy (CRT). In order to classify the different evolution patterns, after reducing the dimensionality of the data by MCA, a similarity measure is introduced to cluster the observed data set from 41 CRT patients. Exploration of all the data base allows to discover that the obtained clusters, compared with the annotations on each patient's medical record, occupy two areas on the factorial plane, one being correlated with a health degradation of patients and the other with a stable clinical state.

In the second methodology, the dynamics of individual time series are characterized by a set of Hidden Semi-Markovian Models (HSMM). In this case, a detection method that exploits not only the instantaneous values, but also the intrinsic dynamics of the temporal series, is proposed. The hidden semi-Markov model is proposed to discover the temporal evolution of observed series and different pre-processing methods of these series are investigated. The detector is based on the comparison of the likelihood that a given observation being generated by a reference HSMM or a pathological HSMM. As an illustration, the intrinsic dynamics of the RR series of 18 preterm newborns acquired in neonatal intensive care units (NICU) are analysed in order to discover predictive patterns of the bradycardia. Unusual and recurrent bradycardias in preterm babies often revealed important disorders such as late-onset sepsis. In view of the high morbidity and mortality associated with infection, rapid detection is requested. The approach was quantitatively evaluated. Compared to two conventional detectors used in NICU, our detector shows an improvement of around 13% in sensitivity and 7% in specificity and also reduces the detection delay of approximately 3 seconds with respect to conventional detectors.

Keywords: predictive models, knowledge discovery, cardiooogy.

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Otvorila sažetak / Extended abstract

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Literature