Influence of the Heart Rate Variability Representations on the Quantification of the Cardiorespiratory Interactions

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Background: Heart Rate Variability (HRV) analysis provides insights into the functioning of the Autonomic Nervous System (ANS) modulation of the Heart Rate (HR). This modulation is commonly described by the tachogram, but other tools, such as the Integral Pulse Frequency Modulation (IPFM) model and the point process model, have also been used. Each of these methods produces a different HRV representation. Furthermore, the HR oscillations are commonly driven by multiple sources, but the most known external driver is the respiration via the Respiratory Sinus Arrhythmia (RSA), i.e. an increased HR during inhalation and a decreased HR during exhalation. The quantification of this interaction can be investigated with different methods. Two of them are the subspace projections and the Time Frequency (TF) representations.
Aim: The objective of this study is to compare the quantification of the RSA using the different HRV representations, while changes in the autonomic regulation of the heart are induced.
Methods: A dataset containing electrocardiogram and inductance plethysmograph signals from 14 volunteers was used. The acquisition was done during a protocol in which the sympathetic and parasympathetic branches of the ANS were selectively blocked combining pharmacological blockades and posture changes. After R-peak detection, the HRV representations were derived via the interpolated tachogram, the IPFM model and the point process model. For each of these time series, the power in the High Frequency (HF) band was computed. In addition, the RSA was quantified via subspace projections and a quadratic TF representation. Finally, the RSA estimates difference for the three HRV representations was assessed via Kruskall Wallis tests and differences on the RSA due to posture changes were evaluated with Friedman tests.
Results: The RSA quantifications did not differ significantly with the three HRV representations ($p>0.05$). Also, the strength of the RSA was significantly lower in standing compared to supine position ($p<0.05$) when no pharmacological blockade was applied and using any of the compared HRV representations.
Conclusion: The results suggest that the selection of a HRV representation is irrelevant for the analysis of the RSA in this database. However, only data from healthy volunteers was used. The choice of a HRV representation might become important in cases of irregular HR or in noisy recordings.