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*Abstract*

# Assessing Transfer Entropy in Cardiovascular and Respiratory Time Series: A VARFI Approach †

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In the study of complex biomedical systems represented by multivariate stochastic processes, such as the cardiovascular and respiratory systems, an issue of great relevance is the description of the system dynamics spanning multiple temporal scales. Recently, the quantification of multiscale complexity based on linear parametric models, incorporating autoregressive coefficients and fractional integration, encompassing short term dynamics and long-range correlations, was extended to multivariate time series. Within this Vector AutoRegressive Fractionally Integrated (VARFI) framework formalized for Gaussian processes, in this work we propose to estimate the Transfer Entropy, or equivalently Granger Causality, in the cardiovascular and respiratory systems. This allows to quantify the information flow and assess directed interactions accounting for the simultaneous presence of short-term dynamics and long-range correlations. The proposed approach is first tested on simulations of benchmark VARFI processes where the transfer entropy could be computed from the known model parameters. Then, it is applied to experimental data consisting of heart period, systolic arterial pressure and respiration time series measured in healthy subjects monitored at rest and during mental and postural stress. Both simulations and real data analysis revealed that the proposed method highlights the dependence of the information transfer on the balance between short-term and long-range correlations in coupled dynamical systems.