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Seminar 2021/2022

Multivariate and multiscale complexity under long-range correlation: application in cardiovascular variability

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December 17, 2021, 16h30, via zoom
https://videoconf-colibri.zoom.us/j/86389857315

An intrinsic feature of some physiological or econometric systems, is their dynamical complexity, resulting from the activity of several coupled mechanisms operating across multiple temporal scales. The cardiovascular system is one of such systems and specific complex characteristics such as long memory and volatility have been considered from a model based ARFIMA-GARCH parametric viewpoint. Entropy rate is another current measure of complexity. Recently, an efficient estimation of the linear multiscale entropy (MSE) was introduced using a state space formulation, able to attend the simultaneous presence of short-term dynamics and long-range correlations by using ARFI modeling. Given the interactions present in these systems, natural generalizations consider a multivariate approach with VARFI models. Within this framework, for Gaussian processes, we propose to estimate the Transfer Entropy, or equivalently Granger Causality, allowing to quantify the information flow and assess directed interactions accounting for long-range correlations.

The methods are applied in experimental and clinical cardiovascular stress situations, allowing to discriminate between health and disease and to assess disease severity. Moreover the developed measures appear to reflect the changes in the cardiovascular variability system dynamics.

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