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Mutual Information Statistics for Electro-Seismic Time Series

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We study the statistical properties of the average mutual information I considered as a coarse-grained observable of a time data series. An application to seismic signals, in particular to an electroseismic one, build with two orthogonal components and associated to an earthquake of $M > 7.4$, is presented. The time series is divided in N windows of size m, and we compute I on each window, hence a new series I_m is obtained. Also, we compute a re-scaled average mutual information index $\lambda(I_m)$, which provides a measure of the strength of nonlinear correlations between these two components on each window. That index is compared with the correlation coefficient, ρ_m, which only detects the linear dependencies between both components. We found that the associated series $\lambda(I_m)$ displays an irregular but structured behavior indicating strong correlation. We clearly identify three different periods corresponding to the preparation and emergence periods of an earthquake. Hence, we conclude that I_m, or $\lambda(I_m)$, provides us relevant information about the precursory period of a strong earthquake.