

Time series characterization by Information Theory based quantifiers

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Objectives: This short course will provide participants a broad overview on the new tools based on Information Theory for the time series datasets characterization and identification of its dynamical behavior.

Syllabus:

- 1) Time series and Information Theory. Chaotic dynamics as information sources.
- 2) Information Theory quantifiers: Shannon entropy and Fisher Information for continuous and discrete PDFs.
- 3) Information Theory quantifiers: Statistical Complexity. Simple and complex. Cristal and ideal gas. Meaning of Complexity. Statistical Complexity ($C=HxQ$)
- 4) Functional forms for the disorder H and disequilibrium Q .
- 5) Maximum and minimum of Generalized Statistical Complexity. Application to logistic map.
- 6) Time series & how to associate a PDF.
- 7) PDF – frequency counting. Shakespeare and other English Renaissance authors.
- 8) PDF – histogram and amplitudes. The logistic map.
- 9) PDF – frequency (Fourier Transform) and frequency bands (Wavelet Transform) representation. EEG tonic-clonic epileptic records.
- 10) PDF – ordinal patterns (Bandt-Pompe methodology). Chaos, non-correlated noise and k -noise (correlate). Logistic map and white noise. Chaotic dynamics plus additive noise.
- 11) The Amigó paradigm: forbidden/missing patters.
- 12) Causal Fisher Information. Shannon-Fisher plane. Chaotic and stochastic dynamics.
- 13) PDF-weighted Bandt-Pompe.
- 14) PDF-Bandt-Pompe for low precision time series.
- 15) Time series as complex network. Node degree distribution.
- 16) PDF – Horizontal Visibility Graph. Distinguishing chaos from noise. The lambda rule. Shannon-Fisher plane.
- 17) PDF – Horizontal Visibility Graph variations. Entropy-complexity plane. Complex network quantifiers
- 18) Applications – I : pseudo random numbers generators
- 19) Applications – II : EEG rhythms and neuronal activity
- 20) Applications – III : El Niño/Southern Oscillation
- 21) Applications – IV : Economic time series
- 22) Applications – V : Classical-quantum transition
- 23) Applications – VI : Handwritten signatures
- 24) Applications – VII : Rivers streamflow
- 25) Entropy-Complexity Plane and Shannon-Fisher Plane of Complex Networks.