Dynamical estimates of chaotic systems from Poincaré recurrences

Murilo S. Baptista
Centro de Matemática da Universidade do Porto
Rua do Campo Alegre 687, 4169-007 Porto, Portugal
Dariel M. Maranhão
Instituto de Física, Universidade de São Paulo
Caixa Postal 66318, 05315-970, São Paulo, SP, Brazil
José C. Sartorelli
Instituto de Física, Universidade de São Paulo
Caixa Postal 66318, 05315-970, São Paulo, SP, Brazil

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Abstract

We show that the probability distribution function that best fits the distribution of return times between two consecutive visits of a chaotic trajectory to finite size regions [1, 2] in phase space deviates from the exponential statistics by a small power-law term, a term that represents the deterministic manifestation of the dynamics, which can be easily experimentally detected and theoretically estimated. We also provide simpler and faster ways to calculate the positive Lyapunov exponents and the short-term correlation function by either realizing observations of higher probable returns or by calculating the eigenvalues of only one very especial unstable periodic orbit of low-period. Finally, we show how to calculate the Kolmogorov-Sinai entropy of arbitrary complex signals and the mutual information between two sets of arbitrary complex signals using recurrences, an approach that offers an ideal way to deal with data coming from complex systems.

Keywords: Poincaré recurrences, entropy, mutual information, Lyapunov exponent, correlation, complex systems.

References

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