Dynamics in Time Series: Characterization and Construction

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Abstract

Plasma experiments and models are characterized not only by the specifics of their construction but by the nature of the output they produce. Data streams are examined for statistical or dynamical signatures, and new types of signatures are necessary additions to the descriptive toolbox. The Hurst exponent is a measure of correlations (on all time scales) which has been used to describe the dynamics in various plasma experiments. Rescaled range (R/S) analysis is the original method for finding the Hurst exponent, and this poster further investigates the dynamical information contained in this analysis. To address this issue, techniques to produce synthetic data series with known properties are developed. Well−known algorithms exist for making fractional Gaussian noises, and using these noises, a simple procedure for constructing correlated data with an arbitrary distribution is examined. This is done by very selective rearrangement of a series with the desired distribution. The effects of rearrangement on specific time scales is also examined, shedding light on processes which produce different dynamics on different time scales (which surfaces as different slopes on R/S graphs). Last but not least, there is a continuing effort to distill additional dynamical information with new R/S−like analyses. These new techniques should capture the essence of higher−order spectral analyses: bispectra, trispectra, etc. The hope is that the dynamical properties of a data set can be better/completely described by a hierarchy of Hurst−like measures.