Towards Coherent Estimation of the Correlation Dimension

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Abstract

A new method for coherent estimation of scaling exponents is presented and demonstrated in the context of the correlation dimension. The method is based on contrasting the distribution of Takens' estimators at a given length scale (which is known to be Gaussian) with the distribution of those estimators at smaller length scales (which is again Gaussian, but typically has larger variance). Requiring consistency with all smaller length scales allows a coherent (that is, internally consistent) estimate of the correlation dimension. It is not possible, of course, to place (non-trivial) bounds on the true dimension with any finite sample. The technique is developed and illustrated on sets where the dimension is known a priori. Macroscopic structure of more typical fractal sets is shown to limit the accuracy with which the correlation dimension is known, even for well studied sets like the Hénon attractor.