Capturing correlations in chaotic diffusion by approximation methods

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We investigate three different methods for systematically approximating the diffusion coefficient of a deterministic random walk on the line which contains dynamical correlations that change irregularly under parameter variation. Capturing these correlations by incorporating higher order terms, all schemes converge to the analytically exact result. Two of these methods are based on expanding the Taylor-Green-Kubo formula for diffusion, whilst the third method approximates Markov partitions and transition matrices by using the escape rate theory of chaotic diffusion. We check the practicability of the different methods by working them out analytically and numerically for a simple one-dimensional map, study their convergence and critically discuss their usefulness in identifying a possible fractal instability of parameter-dependent diffusion, in case of dynamics where exact results for the diffusion coefficient are not available.

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