Ultra-slow diffusion in processes with preferential relocations to places visited in the past

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An important class of random walks includes those in which the random increment at time step depends on the complete history of the process [1, 2]. These strongly non-Markovian random walks offer a promising modeling framework in order to understand the mobility and spreading of living organisms [3-5], yet, few analytical results are available for these processes [6, 7]. In this work we model a system where a walker can either move randomly (explore locally) or stochastically relocates at a site occupied at some earlier time (via long distance steps according to a reinforced rule and characterized by a memory parameter). The emergence of frequently visited locations generates ultra-slow diffusion, logarithmic in time, whereas the walker probability density tends to a Gaussian. In this system we also study the response of the non-Markovian walks to the presence of a constant bias, where a higher probability is assigned in a prescribed direction. The predictions of the analytical expressions obtained in the asymptotic limit are in excellent agreement with numerical simulations.

References

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