Optimal random searches of revisitatable targets: crossover from superdiffusive to ballistic random walks

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One of the most important aspects in the general search problem [1] of finding randomly located target sites is to characterize the role played by the nonrevisitability delay time \( \tau \) during which a previously found target becomes unavailable to the searcher [2]. By using an appropriate parameterization of the number of random walk steps undertaken between successive targets, as \( \tau \) increases from \( \tau \to 0 \) to \( \tau \to \infty \), we show that the optimal search strategy shifts, respectively, from a superdiffusive to a ballistic strategy of essentially rectilinear motion between the targets, in the case of sparse randomly distributed sites. The crossover between these limiting regimes is a function of \( \tau \). Such conclusions are shown to hold even if dissipative phenomena are considered in the searching dynamics [3]. We also discuss the results in the context of their application to animal foraging. [1] G. M. Viswanathan, S. V. Buldyrev, S. Havlin, M. G. E. da Luz, E. P. Raposo, and H. E. Stanley, Nature 401, 911 (1999). [2] E. P. Raposo, S. V. Buldyrev, M. C. Santos, M. G. E. da Luz, H. E. Stanley, and G. M. Viswanathan, Phys. Rev. Lett. 91, 240601 (2003). [3] M. G. E. da Luz, S. V. Buldyrev, S. Havlin, E. P. Raposo, H. E. Stanley, and G. M. Viswanathan, Physica A 295, 89 (2001).

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