Record Statistics of Non-Markovian Random Walks

M. Reza Shaebani, Nicolas Mooij, and Ludger Santen

Department of Theoretical Physics, Saarland University, Saarbrücken, Germany

Understanding the statistics of extreme events in stochastic processes is of crucial importance in a variety of fields, ranging from sport, to climates and biology. While record statistics of a few types of Markovian random walks, such as ordinary and biased walks, have been studied, there is much less known about the extreme events in non-Markovian random walks. To understand the impact of carrying a memory of the previous steps on the record statistics, we investigate a few types of non-Markovian random walks with different types of memories: persistent, elephant and Alzheimer random walks. Persistent walks carry a short-range memory of the previous directions of motion. We show how this correlation between the turning angles of the walker influences the short time behavior of the number of records and their ages. We show that the persistency changes the frequency of the records and affects the crossover time to asymptotic ordinary diffusive dynamics. We also study elephant walks, which carry the whole memory of the previous steps. We verify that, in a specific region of the phase space of the elephant walk's parameters, the record statistics differ from those of an ordinary random walk. Finally, an Alzheimer walker follows the same dynamics as an elephant walker, with the difference that its memory is limited to a fraction of the previous steps of motion. We show how this limited range of the memory leads to a strong bias and influences the record statistics.