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A simple model of a sequence-reading diffusion: non-self-averaging and self-averaging properties

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Motivated by a question about the sensitivity of knots' diffusive motion to the actual sequence of nucleotides placed on a given DNA, here we study a simple model of a sequence-reading diffu- sion on a stretched chain with a frozen sequence of "letters" A and B, having different interaction energies. The chain contains a single distortion - a hernia - which brings the two letters at its bottom together such that they interact. Due to interactions with the solvent, the hernia performs a random hopping motion along the chain with the transition rates dependent on its actual posi- tion. Our two focal questions are a) the dependence of various transport properties on the letters' interaction energy and b) whether these properties are self-averaging with respect to different re- alizations of sequences. We show that the current through a finite interval, the resistance of this interval and the splitting probabilities on this interval lack self-averaging. On the contrary, the mean first-passage time through a finite interval with N sites and the diffusion coefficient in a pe- riodic chain are self-averaging in the limit N going to infinity. Concurrently, two latter properties exhibit sample-to-sample fluctuations for finite N, as evidenced by numerical simulations.

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