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Resetting search for multiple targets

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Research into stochastic processes with resetting is currently in a phase of intensive development. After the initial period, when the main effects of optimizing target search in basic random walk models were identified, researchers moved on to studying more complex problems with a focus on their practical aspects. One example is the process of sequentially locating/destroying multiple targets by a random walker, as a prototype of the DNA repair process.

In this report, we show that such a process can be fully described in terms of the theory of random walks with resetting along a one-dimensional lattice with a single target that we developed earlier [1]. For the case of clusters of targets located at lattice nodes, exact analytical expressions for the mean times Tm of the consecutive annihilation of all m targets, as well as a recursive relationship, are found. Calculations show that in certain topologies of the model, the counter-intuitive effect of accelerated annihilation with increasing m, Tm < Tm-1 (or with increasing the distance between targets), is maintained for $m > 1$ in both infinite and finite chains. In the latter, the effect is present even in the absence of resetting. We analyse in detail the nature of this effect and show that it is not generated by Poissonian resetting, which rather weakens the effect, but by the statistical properties of random walks [2].

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1. L.N. Christophorov. J. Phys. A: Math. Theor. 54, 015001 (2021); J. Phys. A: Math. Theor. 55, 155006 (2022); Ukr. J. Phys. 69, 591 (2024).
2. L.N. Christophorov. J. Phys. A: Math. Theor. 59, 015002 (2026).

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