Where to place a hole to achieve a maximal diffusion coefficient

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A particle moving deterministically in a chaotic spatially extended environment can exhibit normal diffusion, with its mean square displacement growing proportional to the time. Here we consider the dependence of the diffusion coefficient on the size and the position of dynamical channels ('holes') linking spatial regions. The system properties can be obtained analytically via a Taylor-Green-Kubo formula in terms of a functional recursion relation, leading to a diffusion coefficient varying with the hole positions and non-monotonically on their size. We derive analytic formulas for small holes in terms of periodic orbits covered by the holes. The asymptotic regimes that we observe show deviations from a simple random walk approximation, a phenomenon that should be ubiquitous in dynamical systems and might be observed experimentally. The escape rate of the corresponding open system is also calculated. The resulting parameter dependencies are compared with the ones for the diffusion coefficient and explained in terms of periodic orbits.

[1] G.Knight, O.Georgiou, C.Dettmann, R.Klages, preprint arXiv:1112.3922 (Dec. 2011)