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Diffuse globally, compute locally: a cyclist approach to modeling long time robot locomotion TINGNAN ZHANG, DANIEL GOLDMAN, PREDRAG CVITANOVIĆ, Georgia Institute of Technology — To advance autonomous robots we are interested to develop a statistical/dynamical description of diffusive self-propulsion on heterogeneous terrain. We consider a minimal model for such diffusion, the 2-dimensional Lorentz gas, which abstracts the motion of a light, point-like particle bouncing within a large number of heavy scatters (e.g. small robots in a boulder field). We present a precise computation (based on exact periodic orbit theory formula for the diffusion constant) for a periodic triangular Lorentz gas with finite horizon. We formulate a new approach to tiling the plane in terms of three elementary tiling generators which, for the first time, enables use of periodic orbits computed in the fundamental domain (that is, 1/12 of the hexagonal elementary cell whose translations tile the entire plane). Compared with previous literature, our fundamental domain value of the diffusion constant converges quickly for inter-disk separation/disk radius > 0.2, with the cycle expansion truncated to only a few hundred periodic orbits of up to 5 billiard wall bounces. For small inter-disk separations, with periodic orbits up to 6 bounces, our diffusion constants are close ($< 10\%$) to direct numerical simulation estimates and the recent literature probabilistic estimates.

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