

ACMS Graduate and Postdoc Seminar

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Wednesday, October 1, 2025
154 Hurley Hall
3:30 PM – 4:30 PM

The Effect of Target Orientation on the Mean First Passage Time of a Brownian Particle to a Small Elliptical Absorber

We develop a high order asymptotic expansion for the mean first passage time (MFPT) of the capture of Brownian particles by a small elliptical trap in a bounded two dimensional region. This new result describes the effect that trap orientation plays on the capture rate and extends existing results that give information only on the role of trap position on the capture rate. Our results are validated against numerical simulations which confirm the accuracy of the asymptotic approximation. In the case of the unit disk domain, we identify a bifurcation such that the high order correction to the global MFPT (GMFPT) is minimized when the trap is orientated in the radial direction for traps centered at $0 < r_c := \sqrt{2 - \sqrt{2}}$. When centered at position $r_c < r < 1$, the GMFPT correction is minimized by orientating the trap in the angular direction. In the scenario of a general two-dimensional geometry, we identify the orientation that minimizes the GMFPT in terms of the regular part of the Neumann Green's function. This theory is demonstrated on several regular domains such as disks, ellipses and rectangles.

The Department of Applied and Computational
Mathematics and Statistics

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