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Leveraging large fluctuations for stochastic control in uncertain environments[1] IRA SCHWARTZ[2], Naval Research Lab, CHRISTOFFER HECKMAN, University of Colorado, M. ANI HSIEH, Drexel University — We present the development of a stochastic control strategy that leverages the environmental dynamics and uncertainty to navigate in a stochastic fluidic environment. We assume that the domain is composed of the union of a collection of disjoint regions, each bounded by Lagrangian coherent structures (LCSs). We analyze a passive particle's noise-induced transition between adjacent LCS-bounded regions and show how most probable escape trajectories with respect to the transition probability between adjacent LCS-bounded regions can be determined. Additionally, we show how the likelihood of transition can be controlled through minimal actuation. The result is an energy efficient navigation strategy that leverages the inherent uncertainty of the surrounding flow field for controlling sensors in a noisy fluidic environment. We experimentally validate the proposed control strategy and show that the single vehicle control parameter exhibits a predictable exponential scaling with respect to the escape times and is effective even in situations where the structure of the flow is not fully known and control effort is costly.

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