Efficient computation of sharp large deviation limits and prefactors in high-dimensional systems

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Freidlin-Wentzell theory of large deviations can be used to compute the likelihood of extreme or rare events in stochastic dynamical systems via the solution of an optimization problem. The approach gives exponential estimates that often need to be refined via calculation of a prefactor. In this talk, it is shown how these computations can be performed in practice: We will discuss explicit formulas to compute prefactor contributions for high-dimensional systems that yield sharp estimates for probabilities, mean first passage times, or probability densities. The derived results can be interpreted either as generalization of Gel'fand-Yaglom techniques from quantum field theory, as zeta-regularization of functional determinants, or as Fredholm-determinants of the second variation of the Freidlin-Wentzell action. The applicability of the method will be demonstrated on real-world examples such as high surface height probabilities in the Kardar-Parisi-Zhang equation or large strain events in the three-dimensional incompressible Navier-Stokes equation.