An adaptive high-order minimum action method

Stochastic Nonlinear Data-reduction Methods with Detection and Prediction of Critical Rare Events

Xiaoliang Wan
Louisiana State University
Baton Rouge, LA 70803

Abstract

In this work, we present an adaptive high-order minimum action method for dynamical systems perturbed by small noise. We use the *hp* finite element method to approximate the minimal action path and nonlinear conjugate gradient method to solve the optimization problem given by the Freidlin-Wentzell least action principle. The gradient of the discrete action functional is obtained through the functional derivative and the moving mesh technique is employed to enhance the approximation accuracy. We also discuss the preconditioner for the nonlinear conjugate gradient method and the parallel strategy of the algorithm to make it suitable for large scale simulations. Numerical examples are given to demonstrate the efficiency and accuracy of the proposed numerical method. In particular, we apply the developed method to the Kuramoto-Sivashinsky equation, which is of physical interest to study the effect of noise for spatially extended systems.