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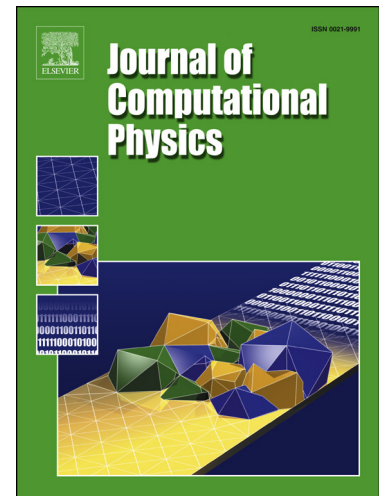
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Polynomial chaos representation of databases on manifolds

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Abstract

Characterizing the polynomial chaos expansion (PCE) of a vector-valued random variable with probability distribution concentrated on a manifold is a relevant problem in data-driven settings. The probability distribution of such random vectors is multimodal in general, leading to potentially very slow convergence of the PCE. In this paper, we build on a recent development for estimating and sampling from probabilities concentrated on a diffusion manifold. The proposed methodology constructs a PCE of the random vector together with an associated generator that samples from the target probability distribution which is estimated from data concentrated in the neighborhood of the manifold. The method is robust and remains efficient for high dimension and large datasets. The resulting polynomial chaos construction on manifolds permits the adaptation of many uncertainty quantification and statistical tools to emerging questions motivated by data-driven queries.

Keywords: Polynomial chaos expansion, Arbitrary probability measure, Concentration of probability, Measure concentration, Generator, Probability distribution on manifolds, Random sampling generator, MCMC generator, Diffusion maps, Statistics on manifolds

Notations

A lower case letter such as x , η , or u , is a real deterministic variable.

A boldface lower case letter such as \mathbf{x} , $\boldsymbol{\eta}$, or \mathbf{u} is a real deterministic vector.

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