

A multi-index Monte Carlo exponential integrator method for semilinear SPDEs

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The multi-index Monte Carlo method (MIMC) is an extension of the multi-level Monte Carlo method (MLMC). MLMC improves the efficiency of Monte Carlo methods applied to forward uncertainty quantification for stochastic equations by considering a hierarchical sampling on a sequence of levels. MIMC replaces the levels by a vector of indices and may improve the efficiency further. In this ongoing project, we show that MIMC outperforms MLMC when applied to parabolic stochastic PDEs (SPDEs). This holds provided that the discretization scheme of the SPDE has a high second-order difference decay rate. We show that this property is attained by the accelerated exponential Euler scheme of Jentzen and Kloeden. The results hold for a semilinear SPDE with a sufficiently smooth Nemytskij type non-linearity in the drift and with affine linear space-time noise of Itô type.

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