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Randomized Numerical Schemes for SDE/SPDEs

Abstract

It is demanding to approximate numerical solutions of non-autonomous SDEs where the standard smoothness and growth requirements of standard Milstein-type methods are not fulfilled. In the case of a non-differentiable drift coefficient function f, we, in [1], proposed a drift-randomized Milstein method to achieve a higher order approximation and discussed the optimality of our convergence rates.

We also investigated the numerical solution of non-autonomous semilinear stochastic evolution equations (SEEs) driven by an additive Wiener noise. Usually quite restrictive smoothness requirements are imposed in order to achieve high order of convergence rate. For instance, some general assumption asks for the semilinearity to be infinitely often Fréchet differentiable with bounded derivatives. This condition already excludes any truly nonlinear Nemytskii-type operator. Thus a novel numerical method for the approximation of the solution to the semilinear SEE that combines the drift-randomization technique from [1] with a Galerkin finite element method from [3] is introduced in [2] to address this. It turns out that the resulting method converges with a higher rate with respect to the temporal discretization parameter without requiring any differentiability of the nonlinearity. Our approach also relaxes the smoothness requirements of the coefficients with respect to the time variable considerably.

References

1. R. Kruse and Y. Wu. A randomized Milstein method for stochastic differential equations with non-differentiable drift coefficients, arXiv preprint, arXiv:1706.09964, 2017.

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3. V. Thomée. Galerkin Finite Element Methods for Parabolic Problems. Springer-Verlag, Berlin, 2006.