High order splitting methods for stochastic differential equations

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19 July 2023, **5 - 6pm** c.t. Berlin time
IRTG 2544: "Stochastic Analysis in Interaction"
— Berlin Probability Colloquium —

Abstract

In this talk, we will discuss how ideas from rough path theory can be leveraged to develop high order numerical methods for SDEs. To motivate our approach, we consider what happens when the Brownian motion driving an SDE is replaced by a piecewise linear path. We show that this procedure transforms the SDE into a sequence of ODEs – which can then be discretized using an appropriate ODE solver. Moreover, to achieve a high accuracy, we construct these piecewise linear paths to match certain "iterated" integrals of the Brownian motion. At the same time, the ODE sequences obtained from this path-based approach can be interpreted as a splitting method, which neatly connects our work to the existing literature. For example, we show that the well-known Strang splitting falls under this framework and can be modified to give an improved convergence rate. We will conclude the talk with a couple of examples, demonstrating the flexibility and convergence properties of our methodology. (Joint work with James Foster and Calum Strange, https://arxiv.org/abs/2210.17543)

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