Weak approximation of stochastic differential equations by a multilevel Monte Carlo method using mean square adaptive numerical integration

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In this talk, we present a multilevel Monte Carlo (MLMC) method for weak approximation of stochastic differential equations (SDE) that uses an a posteriori mean square error (MSE) adaptive Euler–Maruyama step-size control in the numerical integration of SDE realizations. MSE adaptivity is useful for weak approximation MLMC methods since it provides a reliable and efficient way to control the statistical error of the weak approximation MLMC estimator. For a large set of low-regularity weak approximation problems, the adaptive Euler–Maruyama method produces output whose weak error is bounded by $\mathcal{O}(\epsilon)$ at the cost $\mathcal{O}(\epsilon^{-2}|\log(\epsilon)|^4)$. This is a lower asymptotic cost than what can typically be obtained by the uniform time-step Euler-Maruyama MLMC method on the given set of problems. The cost reduction is illustrated in numerical studies.

Joint work with Juho Häppölä (Applied Mathematics and Computational Sciences, KAUST, Thuwal, Saudi Arabia) and Raúl Tempone (Applied Mathematics and Computational Sciences, KAUST, Thuwal, Saudi Arabia).