Approximating distribution functions in uncertainty quantification using quasi-Monte Carlo methods

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Quasi-Monte Carlo (QMC) methods are a class of simple but powerful strategies used for evaluating high-dimensional integrals efficiently. The application of QMC methods to approximate expected values associated with solutions to elliptic partial differential equations with random coefficients in uncertainty quantification has been of great interest in recent years. In this talk, we extend this from computing the expected value to the approximation of distribution functions. This is done by reformulating the integrand as an expectation of an indicator function. However, due to discontinuities present in the new integrand, we are unable to obtain the optimal rate of error convergence by directly applying QMC methods. To alleviate this issue, we use preintegration, whereby a carefully chosen variable is integrated out to obtain a function with a sufficient level of smoothness to successfully apply QMC methods. Full theory and the results of numerical experiments will be presented in this talk.