

Application of quasi-Monte Carlo methods to PDEs with random coefficients

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PDEs with random coefficients are an important source of high dimensional problems. One example is the flow through porous medium: because of the near impossibility of modeling the microscopic channels through which water can flow in a porous layer, it is common engineering practice to model the porous medium as a random permeability field. The quantity of interest is therefore an expected value with respect to the random field, leading to a high dimensional integral where the number of variables is as high as the number of parameters needed to model this random field (it can be infinite). In this talk I will explain how quasi-Monte Carlo (QMC) methods can be tailored to a prototype of such integrals. I will discuss the fast construction of higher order QMC methods to improve the convergence rate and the use of multi-level techniques to improve the computational cost. The talk will touch on a number of joint works with Ivan Graham and Rob Scheichl (Bath), Dirk Nuyens (KU Leuven), Christoph Schwab (ETH Zurich), and Ian Sloan, James Nichols, Josef Dick and Quoc Le Gia (UNSW).