Constructing quasi-Monte Carlo methods for high dimensional integrals over the Euclidean space and applications

Frances Y. Kuo, University of New South Wales

Many high dimensional integrals from practical applications are formulated over the Euclidean space, while most quasi-Monte Carlo (QMC) methods are defined over the unit cube. The general strategy to apply QMC methods is to first map the integral into the unit cube by a clever change of variables. However, the transformed integrand in the unit cube rarely falls within the standard QMC setting of weighted Sobolev spaces of functions with mixed first derivatives. In this talk I will introduce a non-standard function space setting for integrands over the Euclidean space, and outline the fast construction of randomly shifted lattice rules that achieve nearly the optimal rate of convergence in this setting. The rules are tailored to the practical integrands via a careful selection of parameters (including the so-called POD weights), with potential applications to option pricing problems, maximum likelihood problems, and PDEs with lognormal random coefficients. The talk is based on a joint paper with Ian Sloan, Ben Waterhouse, and Greg Wasilkowski (J. Complexity, 2010) and a recent joint paper with James Nichols (J. Complexity, 2014).