Quasi-Monte Carlo Methods for PDEs on Randomly Moving Domains

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The problem of modelling processes with partial differential equations posed on randomly moving domains arises in various applications like biology or engineering. We will consider the case when such a random domain is generated by the evolution of some initial domain driven by a random velocity field over a fixed time interval. Since the domain is random, it is not straightforward to define notions like the expectation of the PDE solution. A way to deal with this setting is to pull-back the considered equation to a fixed reference domain and to study the solution of the reformulated problem. In order to approximate the expectation of the solution we will use quasi-Monte Carlo methods. For that reason we will present the needed regularity analysis on the weak formulation of the pull-back of the Poisson equation based on the assumption of a certain parametric regularity of the given velocity field. Our theoretical results will be illustrated by numerical examples which will also be presented. This is a joint work with Ana Djurdjevac, Vesa Kaarnioja and Claudia Schillings.