Randomized Quasi-Monte Carlo Methods for Global Sensitivity Analysis

Sensitivity analysis studies which input parameters of a model are more important in influencing the model output. While local sensitivity analysis methods are performed by simply varying input factors one at a time to study the local response of the output when other input factors are fixed at given nominal values, the global methods simultaneously vary all input factors over their ranges of variation and measure the variation in the model output. To address the higher computational cost for global sensitivity analysis, faster sampling methods are needed. Randomized quasi-Monte Carlo methods have enjoyed increasing popularity in applications due to their faster convergence rate than Monte Carlo, and the existence of simple statistical tools to analyze the error of their estimates similar to Monte Carlo. In this talk, we give a survey of randomized quasi-Monte Carlo methods and transformation methods for low-discrepancy sequences. We show the accuracy of global sensitivity indices can be significantly enhanced by utilizing randomized quasi-Monte Carlo. We also demonstrate that surrogate modeling, constructing computationally efficient models that serve as proxies for the original models, commonly used in global sensitivity analysis, can substantially benefit from randomized quasi-Monte Carlo methods.