A Comparison of Two Sampling Methods for Global Sensitivity Analysis

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In most cases, global sensitivity analysis requires sampling a model at a large number of points in the input space (Monte Carlo), which requires a corresponding sample design. In this paper, we investigate the convergence properties of two different quasi-random sampling designs in variance-based sensitivity analysis - Sobol's Quasi-Monte Carlo (LP-tau) approach, and Latin supercube sampling. We apply the most efficient estimators to calculate first order (Saltelli/Sobol') and total order (Jansen) sensitivity indices. The investigation uses the non-monotonic V-function of Sobol' as base case-study, for which analytical values are available. Different settings of the V-function are tested, varying the number of model inputs and their relative importance, in order to investigate functions of different effective dimensionality.

The results indicate that in general, the Sobol' design performs better, both in terms of convergence rate and absolute error at given sample sizes. However the LSS design appears to offer advantages in specific cases, such as smaller sample sizes and medium dimensionality. Our recommendation is therefore that Sobol' designs should be used when little is known about the underlying function.