Geophysical Research Abstracts
Vol. 13, EGU2011-9751, 2011
EGU General Assembly 2011
© Author(s) 2011

Variance Reduction Techniques for Monte Carlo Methods in Stochastic Hydrogeology

Philipp Guthke and András Bárdossy
Institute of Hydraulic Engineering, University of Stuttgart

In stochastic hydrogeology, Monte Carlo experiments are widely used to estimate and understand the behaviour of complex and highly non-linear systems with uncertain input parameters. Unfortunately, it is often not possible to run an adequate number of simulations, which then necessarily leads to imperfect results.
In classical stochastic theory, a number of techniques exist, which take advantage of the often overlooked fact that random variables used in such stochastic computer models are under the total control of the modeller. They are referred to as variance reduction techniques.
Three of them are discussed here with focus on their adaptation and applicability to a framework of spatial random fields (uncertain soil structure) used for groundwater flow and solute transport models. The method of antithetic variates addresses the sampling of the random variables prior to the simulation whereas the methods of post-stratification and control variates are applied afterwards and include prior knowledge of insufficiency.
The usefulness of the methods is examined with simple, hypothetical, but typical research test cases.
It was shown that variance reduction techniques can easily be applied to frameworks that use stochastic random fields. Furthermore, they lead to a massive reduction of computational time or improve simulation results. This improvement is expressed in statistical significant reduction of estimator variances of various estimators.