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# An Enhanced Lattice Rule with an Optimized Generating Vector for High-Dimensional Sensitivity Analysis

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**Abstract.** This paper presents an advanced stochastic method based on a lattice rule with an optimized generating vector, which has been developed and thoroughly analyzed. A central component of the study is the Unified Danish Eulerian Model (UNI-DEM), a large-scale mathematical model that accurately represents complex physical and chemical processes in the atmosphere. The research compares the proposed lattice rule with the one of the best available methods for the problem under consideration - the modified Sobol sequence, and also the bijectional lattice rule and the Fibonacci-based lattice rule, demonstrating its advantageous in estimating multidimensional integrals. The enhanced approach proves to be robust and computationally efficient, making it highly effective for computing sensitivity indices, a critical aspect of scientific computing. Additionally, variance-based sensitivity analysis techniques, particularly the Sobol' method, have been employed to quantify