Efficient GPU-based Generation of the Scrambled Halton Sequence

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The Halton sequence is one of the first and most popular low-discrepancy sequences. Various modifications of the original construction of Halton have been developed and studied, with the purpose to improve the convergence rate of the resulting quasi-Monte Carlo algorithms. One of the most important types of modification is the scrambling, described by Owen. Since the bases of the number systems that are used are different for every coordinate, the implementation of this technique faces technical difficulties and may be unfeasible for many practical applications, involving high number of coordinates or high number of points of the sequence. In this work we describe and algorithm for efficient GPU-based generation of the Halton sequence with Owen's scrambling for each coordinate, using CUDA. We demonstrate that by employing the GPU the overhead of the scrambling becomes acceptable and we achieve overall better numerical results compared to simpler types of scrambling.