Generic, Parallel Implementation of Multilevel Monte Carlo

Proposal for a Semester/Bachelors'/Masters' Thesis

Project description: Multilevel Monte Carlo (MLMC) has gained much interest in the last few years, in many different applications [1, 2, 3, 4, 5, 6]. Nevertheless, an implementation that can be easily wrapped around existing software is unavailable.

This project attempts to fill this gap by developing a *generic* MLMC wrapper in `C++`, with the goal of allowing straightforward use of this algorithm in relevant high-performance scenarios. The focus will be on *generic programming*, *software design* and *high-performance computing* using MPI.

Documentation of the resulting wrapper should formulate C++ *concepts* describing the concrete requirements on the implementation of the inner function evaluated on the different levels. Various applications are available to validate the implementation.

Goals:

- formulation of requirements on the implementation of the generic problem
- implementation of an MLMC wrapper for problems of the above type
- MPI parallelization of the wrapper (specifically including *nested* parallelization and various scheduling methods [7, 8])
- application to a concrete problem (to be determined)
- testing and benchmarking of the implementation (parallel scaling, comparison of scheduling methods,...)
- documentation and listing of examples demonstrating various use cases

Main Topics:

- `C++` implementation
- Software Design
- High Performance Computing with MPI

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References

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