A parallel dynamic asynchronous framework for Uncertainty Quantification and Ensemble Average

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ABSTRACT

The presence of unknown parameters and of finite time windows characterizes many engineering and physical systems, and leads to uncertain solutions. Therefore, specific algorithms are required to perform a proper statistical analysis of the output quantities of interest. Ensemble average and hierarchical Monte Carlo methods are known to be simple, robust, non-intrusive and general methods to solve finite time horizon and stochastic problems, respectively. In particular, ensemble average can be run on top of a standard Monte Carlo framework.

Nowadays, the increasing of supercomputing capabilities is making the development of parallel and distributed computing software a necessary step towards exascale computations.

These two key points lead to the necessity of developing software which are both statistically reliable and computationally efficient. Such developments make possible to solve problems in modern supercomputers, which could not be solved in the past.

The aim of this work is to briefly introduce the scalable, dynamic, asynchronous framework we developed to run hierarchical Monte Carlo methods in supercomputers, and to present applications of engineering relevance [1, 2]. The problem is the wind flow past a building, where the wind inlet generates turbulence. The first scenario presents known boundary conditions and finite time window, and the ensemble average technique is applied through the Monte Carlo framework. The second example presents both oscillating wind inflow and finite time horizon, and it is solved with the Monte Carlo method. In addition, in this last scenario, the joint use of Monte Carlo and ensemble average is explored. The output quantities of interest are forces and pressure on the building, and risk measure analyses are conducted on these variables.

REFERENCES
