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A hybrid parareal Monte-Carlo algorithm for the parabolic time dependant diffusion equation

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In this work, we examine a hybrid Monte-Carlo/deterministic resolution for the parabolic time-dependent diffusion equation as a toy problem. The aim is to treat neutron transport problems where these Monte-Carlo resolutions are most often called for.

We consider two different solvers: a "coarse"solver based on a deterministic finite-element resolution and a "fine"solver based on a Monte-Carlo resolution. We use a hybrid "parareal in time"algorithm based on these two solvers to reduce the computational time of the full Monte-Carlo simulation.

In the numerical experiments, we compare our parareal strategy with a standard full Monte-Carlo solution of the diffusion equation. In particular, we show that for a large number of processors, our adaptive strategy significantly reduces the computational time of the simulation. The convergence properties of the proposed Monte-Carlo/deterministic parareal strategy are also discussed in this work.

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