Second-order space-time parallel methods for diffusion-dominated problems and extension to reaction-diffusion problems

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Abstract: The existing limits of sequential computing have led the community to adopt new strategies to improve the speedup of numerical simulations. Among them, parallelization has gained popularity in recent years. In the context of evolutionary parabolic problems, space-time parallel solvers are integrators of great interest on the grounds of their optimal use of the processors available.

In this work, we present a new family of space-time parallel methods based on the combination of the parallel-in-time parareal algorithm (cf. [2]) and suitable splitting techniques that permit us to perform space parallelization. In particular, the elliptic operator is partitioned into simpler suboperators, using either dimensional or domain decomposition splittings (cf. [3]). Then, second-order splitting time integrators are considered as the propagators of the parareal algorithm to solve the split problem (see [1] for a comprehensive study).

A theoretical analysis of convergence is performed for diffusion-dominated problems, and the methods are further extended in order to solve reaction-diffusion problems. In that regard, numerical experiments are shown so as to confirm the potential of the proposed solvers.

References:

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