Space-time parallel parareal methods for the solution of parabolic problems

Laura Portero (Public University of Navarre), Iñigo Jimenez, Andres Arraras, Francisco J. Gaspar

Many phenomena in science and engineering are governed by evolutionary partial differential equations. In scenarios involving three-dimensional models or long-term simulations, the computational workload can become a significant bottleneck in achieving fast and accurate solutions. To fully leverage the computational power of modern parallel clusters, extensive research is underway in the area of space-time parallel methods. In this talk, we propose an approach that combines the parallel-in-time parareal algorithm with various time-splitting schemes, enabling spatial parallelization. We will explore both dimensional and domain decomposition partitioning strategies for solving parabolic problems. A key advantage of these methods is that both the fine and coarse propagators operate in parallel, in contrast to the classical parareal algorithm, where all processors remain idle during coarse propagator computations. This approach uses parallel computational cores for both integrators, significantly enhancing efficiency. We provide a convergence analysis of the proposed methods and present several numerical experiments to evaluate the performance of the solvers.

[link to pdf] [back to Numdiff-17]