

Parallel-in-Time Solver for the Runge–Kutta Discretization of the Heat Equation

Santolo Leveque

Charles University, Prague, Czech Republic
SANTOLO.LEVEQUE@MATFYZ.CUNI.CZ

Abstract

Time-dependent PDEs arise quite often in many scientific areas, such as mechanics, biology, economics, or chemistry, just to name a few. Of late, researchers have devoted their effort in devising parallel-in-time methods for the numerical solution of time-dependent PDEs, adding a new dimension of parallelism and allowing to speed-up the solution process on modern supercomputers.

In this talk, we present a parallel-in-time preconditioner for the space-time discretization of the heat equation arising when employing a Runge–Kutta method in time. The resulting system is solved iteratively for the numerical solution and for the stages of the method. The proposed preconditioner results in a block-diagonal solve for the stages, and a Schur complement obtained by solving again systems for the stages. A range of numerical experiments validate the robustness of the preconditioner with respect to the discretization parameters and to the number of stages, showing the speed-up achieved on a parallel architecture.