MINISYMPOSIUM 10: Time Domain Decomposition Methods for Evolution Problems

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Time Domain Decomposition methods are methods which decompose the time dimension of an evolution problem into time-subdomains, and then compute the solution trajectory in time simultaneously in all the time subdomains using an iteration. The advent of the parareal algorithm by Lions, Maday and Turinici in 2001 sparked renewed interest in these methods, and there are now several convergence results available for them. In particular, these methods exhibit superlinear convergence on bounded time intervals, a proof of which can be found in the paper of the plenary lecture given by Gander in this volume. While the speedup with parallelization in time is often less impressive than with parallelization in space, parallelization in time is for problems with few spatial components, or when using very many processors, often the only option, if results in real time need to be obtained. This reasoning also led to the name parareal (parallel in real time) of the new algorithm from 2001.

In the first paper, Bal and Wu show that the parareal algorithm applied to a Hamiltonian system is not symplectic, even if the fine and coarse solver in the parareal algorithm are symplectic. They then present a new type of time splitting, replacing the sum of coarse and fine approximate solutions in the parareal scheme by the composition of symplectic coarse and fine approximations. This leads to a symplectic time parallel method, and numerical experiments illustrate the effectiveness of this new approach.

In the second paper, Sarkis, Schaerer and Mathew present a parareal preconditioner for the solution of parabolic problems arising within an optimal control problem. Using results by Gander and Vandewalle, they prove that the parareal preconditioner is spectrally equivalent to the preconditioned problem, and numerical results confirm their analysis.