Overlapping Domain Decomposition Algorithms for Singularly Perturbed Parabolic Problems

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ABSTRACT

Singularly perturbed problems arise as mathematical models in various physical phenomena. In general, the solutions to singularly perturbed problems exhibit boundary and/or interior layers (narrow regions where the solution changes drastically) due to the presence of small perturbation parameter. Although the layer regions are small, their influence on the overall solution is very significant. Due to layer behavior of the solution, classical numerical approaches are not adequate for solving singularly perturbed problems, as they require prohibitively large numbers of mesh points to produce satisfactory approximations. This leads to the development of so-called parameter-robust or uniformly convergent numerical methods for singularly perturbed problems.

In this talk we will discuss design and analysis of overlapping domain decomposition algorithms of Schwarz waveform relaxation type for solving some classes of singularly perturbed parabolic problems. Besides uniform convergence analysis of the algorithms based on some auxiliary problems, we will discuss much faster convergence of the algorithms for small perturbation parameter. Some numerical results will be given in support of the theoretical findings, and for demonstrating the effectiveness of the algorithms.

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