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Higher-order schemes for the Laplace transformation method for parabolic problems

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In the effective and efficient numerical approximation of parabolic problems, there are three primary issues: the discretization in the time variable, the discretization in the spatial variable, and the linear solver used at each time step. In this work, we propose to solve linear parabolic problems using three stage noble algorithms. The time discretization is approximated using the Laplace transformation method, which is both parallel and has extremely high order convergence. Higher order compact schemes of order four and six are applied in the the spatial discretization. Finally, the discretized linear algebraic systems are solved using MADPACK, which is a highly efficient implementation of various multigrid methods in an abstract problem setting. Numerical results confirm the efficiency of the proposed method and show an ideal parallel speed up on a traditional Linux computing cluster.