Least-squares Spectral Element Methods for Parabolic Problems on Smooth Domains using Parallel Computers

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Abstract - We study least-squares spectral element methods for parabolic initial boundary value problems. The spectral element functions considered are discontinuous at each time step. The method is spectral in both space and time. The normal equations obtained from the least-squares formulation can be solved by the preconditioned conjugate gradient method (PCGM). A preconditioner can be defined for the minimization problem which allows the problem to decouple. The method is based on parallel computer with distributed memory and the library used for massage passing is MPI. If the solution is smooth then for the p-version of the method error between the exact solution and the approximate solution decays exponentially in p. For the h-version error is $O(h^{(2q-1)})$. Moreover, the number of iterations required to obtain the $O((ln(p))^2)$.

approximate solution using PCGM is $O(\frac{(ln(p))^2}{h})^{\cdot}$ per time step. The computational results confirm the estimates that have been obtained.