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The exact formula of the optimal penalty parameter value of the spectral penalty method for differential equations. (English) [Zbl 07208694]

Summary: Spectral penalty methods were originally introduced to deal with the stability of the spectral solution coupled with the boundary conditions for differential equations [Funaro 1986, Funaro and Gottlieb 1988]. Later the penalty method was used for spectral methods to be implemented in irregular domains in multiple dimensions. It has been also shown that there are close relations between discontinuous Galerkin methods and spectral penalty methods in multi-domain and element setting. In addition to stability, the penalty method provides a better accuracy because of its asymptotic behavior in the neighborhood of boundaries. The optimal value of the penalty parameter for accuracy has not been studied thoroughly for the exact form. In this short note, we consider a simple differential equation and study the optimal value of the penalty parameter by minimizing the error in maximum norm. We focus on the optimization for the case of Chebyshev spectral collocation method. We provide its exact form and verify it numerically.

MSC:
00-XX General and overarching topics; collections

Keywords:
spectral penalty method; Chebyshev Gauss-Lobatto collocation; optimal penalty parameter; boundary conditions

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References:
[1] Article ID 746489. - Zbl 1299.76169

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