NUMERICAL ANALYSIS FOR A STABILIZED HYBRID STABILIZED PRIMAL DISCONTINUOUS GALERKIN METHOD FOR THE HEAT PROBLEM

DAIANA S. BARREIRO, CRISTIANE O. FARIA, AND JOSÉ KARAM FILHO

Abstract. In order to obtain a more stable solution to the heat problem in transient regime we propose high-order methods combining a stabilized hybrid method for the spatial variable with linear multistep methods for the time variable. The main reason of this study is due to the appearance of spurious oscillations, in the initial times when no regular data are considered and usual semi-discrete methodologies are applied to the approximation of the heat equation, as noted by I. Harari [1].

The hybrid method, originally introduzed for elliptic problems [2], consisting of coupling local problems resolved by the discontinuous Galerkin method (DG) for the primal variable with a global problem for the Lagrange multiplier, which is identified with the temperature trace, weakly imposing continuity between the elements. This hybrid formulation has the DG methods good characteristics such as stability, robustness and flexibility; however, with reduced complexity and computational cost. A stability analysis of the semi-discrete problem and when an implicit Euler scheme is used in the time aproximation were presented in [3]. Results of some numerical experiments illustrate the flexibility and the robustness of the proposed formulation but reduced complexity and computaional cost. Also is found optimal rate convergence in the $L^2(\Omega)$-norm without spurius oscilations in small times. In this work, we extend this study considering other tests and some modifications in the algorithm.

Keywords: finite elements, hybrid methods, stability analysis, heat problems **Mathematics Subject Classifications (2010)**: 65N30, 35K05

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LNCC/MCTIC, RJ, Brazil
E-mail address: daianasb@lncc.br

UERJ, RJ, Brazil
E-mail address: cofaria@ime.uerj.br

LNCC/MCTIC, RJ, Brazil
E-mail address: jkfi@lncc.br