FINITE ELEMENT METHODS FOR CONVECTION-DIFFUSION PROBLEMS USING EXPONENTIAL SPLINES ON TRIANGLES

Riccardo Sacco and Martin Stynes

A new family of Petrov-Galerkin finite element methods on triangular grids is constructed for singularly perturbed elliptic problems in two dimensions. It uses divergence-free trial functions that form a natural generalization of one-dimensional exponential trial functions. This family includes an improved version of the divergence-free finite element method used in the PLTMG code. Numerical results show that the new method is able to compute strikingly accurate solutions on coarse meshes. An analysis of the use of Slotboom variables shows that they are theoretically unsatisfactory and explains why certain Petrov-Galerkin methods lose their stability when generalized from one to two dimensions. Full details appear in [1].

Reference

[1] R. Sacco and M. Stynes, *Finite element methods for convection-diffusion problems using exponential splines on triangles* (1995) (Preprint 173/P, Mathematics Department, Politecnico di Milano, Milan).

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NECESSARY CONDITIONS FOR UNIFORM CONVERGENCE OF FINITE DIFFERENCE SCHEMES FOR CONVECTION-DIFFUSION PROBLEMS WITH EXPONENTIAL AND PARABOLIC LAYERS

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A difference scheme for a convection-dominated problem is said to be uniformly convergent when its convergence behaviour is essentially independent of the diffusion parameter. In this paper we discuss necessary conditions that uniformly convergent schemes must satisfy in the presence of exponential and parabolic boundary layers. Full details appear in [1].

Reference

[1] H.-G. Roos and M. Stynes, *Necessary conditions for uniform convergence of finite difference schemes for convection-diffusion problems with exponential and boundary layers* (1995) (Math. Appl. (to appear)).

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