

Lin, Tzu-Chu; Schultz, David H.; Zhang, Weiqun

Numerical solutions of linear and nonlinear singular perturbation problems. (English)

Zbl 1142.65306

Comput. Math. Appl. 55, No. 11, 2574-2592 (2008).

Summary: A new method is developed by detecting the boundary layer of the solution of a singular perturbation problem. On the non-boundary layer domain, the singular perturbation problem is dominated by the reduced equation which is solved with standard techniques for initial value problems. While on the boundary layer domain, it is controlled by the singular perturbation. Its numerical solution is provided with finite difference methods, of which up to sixth order methods are developed. The numerical error is maintained at the same level with a constant number of mesh points for a family of singular perturbation problems. Numerical experiments support the analytical results.

MSC:

65C10 Random number generation in numerical analysis

Cited in **3** Documents

Keywords:

singular perturbation; reduced equation; differential equations; numerical solutions; stability

Full Text: DOI

References:

- [1] Chang, K.W.; Howes, F.A., Nonlinear singular perturbation phenomena: theory and application, (1984), Springer-Verlag · Zbl 0559.34013
- [2] O'Malley, R.E., Introduction to singular perturbations, (1974), Academic Press New York · Zbl 0287.34062
- [3] Schultz, D.H.; Choo, J.Y., High order methods for differential equations with small coefficients for the second order terms, Comput. math. appl., 25, 1, 105-123, (1993) · Zbl 0770.65049
- [4] Schultz, D.H.; Ilicasu, F.O., High order methods for singular perturbation problems, Comput. math. appl., 47, 391-417, (2002) · Zbl 1168.76343
- [5] Miller, J.J.H.; O'Riordan, E.; Shishkin, G.I., Fitted numerical methods for singular perturbation problems: error estimates in the maximum norm for linear problems in one and two dimensions, (1996), World Scientific · Zbl 0915.65097
- [6] Segal, A., Aspects of numerical methods for elliptic singular perturbation problems, SIAM J. sci. comput., 3, 3, 327-349, (1982) · Zbl 0483.65059
- [7] W. Zhang, Numerical solutions of linear and nonlinear singular perturbation problems, Ph. D. Dissertation, University of Wisconsin Milwaukee, May 2006
- [8] Linss, T.; Roos, H.; Vulcanovic, R., Uniform pointwise convergence on shishkin type meshes for quasi-linear convection – diffusion problems, SIAM J. numer. anal., 38, 3, 897-912, (2000) · Zbl 0977.65067
- [9] Choudhury, S.R., Nonstandard difference schemes of nonlinear singular perturbation problems, Internat. J. appl. sci. comput., 2, 3, 375-392, (1996)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.