

Gardner, David R.; Trogdon, Steven A.; Douglass, Rod W.

A modified tau spectral method that eliminates spurious eigenvalues. (English)

Zbl 0661.65084

J. Comput. Phys. 80, No. 1, 137-167 (1989).

The tau spectral method proposed by *C. Lanczos* [Applied Analysis (1956; Zbl 0074.105)] for solving eigenvalue problems in ordinary differential equations is modified so that spurious eigenvalues are eliminated. It uses a truncated series expansion of Chebyshev polynomials in a set of complete functions as an approximation for the solution of the differential equation.

The modification involves an appropriate factorization of the differential operator which removes the numerical instability. The modified tau method for a general fourth-order eigenvalue problem, for a system of fourth-order equations, and for the Orr-Sommerfeld stability equation for plane Poiseuille flow is discussed and compared with the ordinary tau method. The modified method converges at least as rapidly as the usual method. The use of the tau coefficients as identifiers of spurious eigenvalues and indicators of convergence is shown.

Reviewer: [V.Burjan](#)

MSC:

- [65L15](#) Numerical solution of eigenvalue problems involving ordinary differential equations
- [34L99](#) Ordinary differential operators

Cited in **13** Documents

Keywords:

[tau spectral method](#); [spurious eigenvalues](#); [truncated series expansion](#); [numerical instability](#); [Orr-Sommerfeld stability equation](#); [Poiseuille flow](#); [convergence](#)

Full Text: [DOI](#)

References:

- [1] Orszag, S.A., Phys. rev. lett., 26, 1100, (1971)
- [2] Orszag, S.A., J. fluid mech., 50, 689, (1971)
- [3] Gottlieb, D.; Orszag, S.A., Numerical analysis of spectral methods, (1977), SIAM Philadelphia · [Zbl 0412.65058](#)
- [4] Lanczos, C., Applied analysis, (), 464-517 · [Zbl 0111.12403](#)
- [5] Brenier, B.; Roux, B.; Bontoux, P., J. theor. appl. mech., 5, 95, (1986)
- [6] Zebib, A., J. comput. phys., 53, 443, (1984)
- [7] Zebib, A., J. comput. phys., 70, 521, (1987)
- [8] Fox, L., Comput. J., 4, 318, (1962)
- [9] Boyd, J.P., J. comput. phys., 57, 454, (1985)
- [10] Gardner, D.R., (), (unpublished)

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.