Namasivayam, S.; **Ortiz, E. L.**

Error analysis of the Tau method: Dependence of the approximation error on the choice of perturbation term. (English) Zbl 0769.65045

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From the author's abstract: A system of ordinary differential equations with constant coefficients and asymptotic estimates for the Tau method approximation error vector per step for different choices of the perturbation term $H_n(x)$ is considered. The resulting Tau method implementation can be arranged into the following scale of increasing error estimates at the end point: Legendre < Chebyshev ≪ Power series < Weighted residuals.

An application of the results to the analysis of singularly perturbed differential equations is discussed.

Reviewer: C.Simerská (Praha)

MSC:

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34A34 Nonlinear ordinary differential equations and systems, general theory

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perturbation; system of ordinary differential equations; constant coefficients; Tau method; error estimates; weighted residuals

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References:

[1] Ortiz, E.L., The tau method, SIAM J. numer. analysis, 6, 480-491, (1969) · Zbl 0195.45701

[2] El Daou, M.; Ortiz, E.L.; Samara, H., A unified approach to the tau methods and to Chebyshev and Legendre series expansion techniques, Imperial college research report, NAS 7-89, 1-9, (1989)

[3] Ortiz, E.L., A recursive method for the approximate expansion of functions in a series of polynomials, Comp. phys. comm., 4, 151-156, (1972)

[4] Lanczos, C., Trigonometric interpolation of empirical and analytical functions, J. math. phys., 17, 123-199, (1938) · Zbl 0020.01301

[5] Freilich, J.H.; Ortiz, E.L., Numerical solution of systems of differential equations with the tau method: an error analysis, Maths. comp., 39, 189-203, (1984)

[6] Crisci, M.R.; Russo, E., An extension of Ortiz' recursive formulation of the tau method to certain linear systems of ordinary differential equations, Maths. comput., 41, 27-42, (1983) · Zbl 0526.65054

[7] Lanczos, C., Applied analysis, (1956), Prentice Hall New Jersey · Zbl 0111.12403

[8] Lanczos, C., Legendre vs. Chebyshev polynomials, (), 191-201

[9] Ortiz, E.L., Step by step tau method: piecewise polynomial approximations, Comp. and maths. with appli., 1, 381-392, (1975) · Zbl 0356.65006

[10] Onumanyi, P.; Ortiz, E.L., Numerical solution of stiff and singularity perturbed boundary value problems segmented-adaptive formulation of the tau method, Math. comput., 43, 189-203, (1984) · Zbl 0574.65091

[11] El Misiery, A.E.M.; Ortiz, E.L., Tau-lines: A new hybrid approach to the numerical treatment of crack problems based on the tau method, Comp. meth. in appl. mech. and engng., 56, 265-282, (1986) · Zbl 0576.73095

[12] Abadi, M.Hosseini Ali; Ortiz, E.L., A tau method based on non-uniform space-time elements for the numerical simulation of solitons, Comp. and maths. with appli., 22, 7-19, (1991) · Zbl 0755.65124

[13] de Boor, C.; Swartz, B., Local piecewise polynomial projection methods for ODE which give higher-order convergence at knots, Math. comput., 36, 21-33, (1981) · Zbl 0456.65056

[14] El Daou, M.; Namasivayam, S.; Ortiz, E.L., Differential equations with piecewise approximate coefficients: discrete and continuous estimation for initial and boundary value problems, Comp. and maths. with appli., (1992), (in press) · Zbl 0763.65053

[15] Rivlin, T.J., The Chebyshev polynomials, (1990), John Wiley \& Sons New York · Zbl 0871.41022

[16] Namasivayam, S.; Ortiz, E.L., A hierarchy of truncation error estimates for the numerical solution of a system of ordinary

differential equations with techniques based on the tau method, (), 113-121 · Zbl 0688.65055

[17] Ortiz, E.L., On the numerical solution of nonlinear and functional differential equations with the tau method, (), 127-139 · Zbl 0387.65053