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A collocation methods based on the quadratic quadrature technique for fractional differential equations. (English) Zbl 1484.65156

Summary: In this paper, we introduce a mixed numerical technique for solving fractional differential equations (FDEs) by combining Chebyshev collocation methods and a piecewise quadratic quadrature rule. For getting solutions at each integration step, the fractional integration is calculated in two intervals: all previous time intervals and the current time integration step. The solution at the current integration step is calculated by using Chebyshev interpolating polynomials. To remove a singularity which belongs originally to the FDEs, Lagrangian interpolating technique is considered since the Chebyshev interpolating polynomial can be rewritten as a Lagrangian interpolating form. Moreover, for calculating the fractional integral on the whole previous time intervals, a piecewise quadratic quadrature technique is applied to get higher accuracy. Several numerical experiments demonstrate the efficiency of the proposed method and show numerically convergence orders for both linear and nonlinear cases.

MSC:
65L60 Finite element, Rayleigh-Ritz, Galerkin and collocation methods for ordinary differential equations
34A08 Fractional ordinary differential equations
65L05 Numerical methods for initial value problems involving ordinary differential equations
65L20 Stability and convergence of numerical methods for ordinary differential equations

Keywords: fractional differential equations; quadratic quadrature; interpolation; Chebyshev collocation; Lagrangian interpolation

Full Text: DOI

References:
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