Youssri, Youssri H.; Abd-Elhameed, Waleed M.; Abdelhakem, Mohamed
A robust spectral treatment of a class of initial value problems using modified Chebyshev polynomials. (English) Zbl 07377144

Summary: New modified shifted Chebyshev polynomials (MSCPs) have been constructed over the interval $[\alpha, \beta]$. These polynomials are utilized as basis functions with the application of the spectral collocation method. The operational matrix of integer order derivatives of these polynomials is introduced. The elements of this matrix are explicitly given. The introduced operational matrix along with the collocation method is used to find a direct solver of linear/nonlinear class of IVPs. Furthermore, the convergence and error analysis of the modified Chebyshev expansion are discussed. Some specific numerical examples are given to ascertain the wide applicability and the good efficiency of the suggested algorithm. The obtained results from the tested numerical examples are convincing. Also, the introduced approximate solutions are very close to the analytical ones.

MSC:
65-XX Numerical analysis
65L60 Finite element, Rayleigh-Ritz, Galerkin and collocation methods for ordinary differential equations
33C45 Orthogonal polynomials and functions of hypergeometric type (Jacobi, Laguerre, Hermite, Askey scheme, etc.)

Keywords:
Chebyshev polynomials; collocation method; convergence analysis; IVPs; modified Chebyshev polynomials

Full Text: DOI