Ali, Khalid K.; Abd El salam, Mohamed A.; Mohamed, Emad M. H.
A numerical technique for a general form of nonlinear fractional-order differential equations with the linear functional argument. (English) [Zbl 07412223]

Summary: In this paper, a numerical technique for a general form of nonlinear fractional-order differential equations with a linear functional argument using Chebyshev series is presented. The proposed equation with its linear functional argument represents a general form of delay and advanced nonlinear fractional-order differential equations. The spectral collocation method is extended to study this problem as a discretization scheme, where the fractional derivatives are defined in the Caputo sense. The collocation method transforms the given equation and conditions to algebraic nonlinear systems of equations with unknown Chebyshev coefficients. Additionally, we present a general form of the operational matrix for derivatives. A general form of the operational matrix to derivatives includes the fractional-order derivatives and the operational matrix of an ordinary derivative as a special case. To the best of our knowledge, there is no other work discussed this point. Numerical examples are given, and the obtained results show that the proposed method is very effective and convenient.

MSC:
65-XX Numerical analysis
34-XX Ordinary differential equations

Keywords:
Caputo fractional derivatives; Chebyshev collocation method; functional argument; nonlinear fractional-order differential equations