Numerical solutions of fractional differential equations by using fractional explicit Adams method

ABSTRACT

Differential equations of fractional order are believed to be more challenging to compute compared to the integer-order differential equations due to its arbitrary properties. This study proposes a multistep method to solve fractional differential equations. The method is derived based on the concept of a third-order Adam–Bashforth numerical scheme by implementing Lagrange interpolation for fractional case, where the fractional derivatives are defined in the Caputo sense. Furthermore, the study includes a discussion on stability and convergence analysis of the method. Several numerical examples are also provided in order to validate the reliability and efficiency of the proposed method. The examples in this study cover solving linear and nonlinear fractional differential equations for the case of both single order as $\alpha \in (0,1)$ and higher order, $\alpha \in [1,2)$, where α denotes the order of fractional derivatives of $D\alpha y(t)$. The comparison in terms of accuracy between the proposed method and other existing methods demonstrate that the proposed method gives competitive performance as the existing methods.

Keyword: Multistep method; Fractional differential equation; Linear FDE; Nonlinear FDE; Single order FDE; Higher order FDE; Fractional Riccati differential equation