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Numerical Solution of Space Fractional Order Linear/Nonlinear Reaction-Advection Diffusion Equation Using Jacobi Polynomial

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Abstract : During modelling of many physical problems and engineering processes, fractional calculus plays an important role. Those are greatly described by fractional differential equations (FDEs). So a reliable and efficient technique to solve such types of FDEs is needed. In this article, a numerical solution of a class of fractional differential equations namely space fractional order reaction-advection dispersion equations subject to initial and boundary conditions is derived. In the proposed approach shifted Jacobi polynomials are used to approximate the solutions together with shifted Jacobi operational matrix of fractional order and spectral collocation method. The main advantage of this approach is that it converts such problems in the systems of algebraic equations which are easier to be solved. The proposed approach is effective to solve the linear as well as non-linear FDEs. To show the reliability, validity and high accuracy of proposed approach, the numerical results of some illustrative examples are reported, which are compared with the existing analytical results already reported in the literature. The error analysis for each case exhibited through graphs and tables confirms the exponential convergence rate of the proposed method.

Keywords : space fractional order linear/nonlinear reaction-advection diffusion equation, shifted Jacobi polynomials, operational matrix, collocation method, Caputo derivative
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