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A New Approach for Solving Fractional Coupled Pdes

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Abstract : In the present article, an effective Laguerre collocation method is used to obtain the approximate solution of a system of coupled fractional-order non-linear reaction-advection-diffusion equation with prescribed initial and boundary conditions. In the proposed scheme, Laguerre polynomials are used together with an operational matrix and collocation method to obtain approximate solutions of the coupled system, so that our proposed model is converted into a system of algebraic equations which can be solved employing the Newton method. The solution profiles of the coupled system are presented graphically for different particular cases. The salient feature of the present article is finding the stability analysis of the proposed method and also the demonstration of the lower variation of solute concentrations with respect to the column length in the fractional-order system compared to the integer-order system. To show the higher efficiency, reliability, and accuracy of the proposed scheme, a comparison between the numerical results of Burger's coupled system and its existing analytical result is reported. There are high compatibility and consistency between the approximate solution and its exact solution to a higher order of accuracy. The exhibition of error analysis for each case through tables and graphs confirms the super-linearly convergence rate of the proposed method.

Keywords : fractional coupled PDE, stability and convergence analysis, diffusion equation, Laguerre polynomials, spectral method
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