New preconditioning and half-sweep accelerated overrelaxation solution for fractional differential equation

ABSTRACT

The present paper investigates the approximate solution of a one-dimensional linear space-fractional diffusion equation using a new preconditioning matrix to develop an efficient half-sweep accelerated overrelaxation iterative method. The proposed method utilizes unconditionally stable implicit finite difference schemes to formulate the discrete approximation equation to the problem. The formulation employs the Caputo fractional derivative to treat the space-fractional derivative in the problem. The paper's focus is to assess the improvement in terms of the convergence rate of the solution obtained by the proposed iterative method. The numerical experiment illustrates the superiority of the proposed method in terms of solution efficiency against one of the existing preconditioned methods, preconditioned accelerated overrelaxation and implicit Euler method. The proposed method reveals the ability to compute the solution with lesser iterations and faster computation time than the preconditioned accelerated overrelaxation and implicit Euler method. The method introduced in the paper, half-sweep preconditioned accelerated overrelaxation, has the potential to solve a variety of space-fractional diffusion models efficiently. Future investigation will improve the absolute errors of the solutions.