Numerical Investigation on the Solution of a Space-Fractional via Preconditioned SOR Iterative Method

ABSTRACT

This paper considers a numerical investigation on the solution of a one-dimensional linear space-fractional partial differential equation with the application of an unconditionally implicit finite difference method and the Caputo's space-fractional derivative. We formulate the Caputo'simplicit finite difference approximation equation to form a corresponding linear system in which its coefficient matrix is large-sized and has a great sparsity. We construct a preconditioned linear system intending to speed up the convergence rate in computing the solutions of the linear system using the SOR iterative method. We present two examples of the one-dimensional linear space-fractional partial differential equation problem to illustrate the effectiveness and efficiency of our proposed PSOR iterative method. Through the investigation, the numerical results show that the proposed PSOR iterative method is superior to the preconditioned Gauss-Seidel and Gauss-Seidel iterative methods in terms of efficiency.