Application of four-point newton- EGSOR iteration for the numerical solution of 2d porous medium equations

ABSTRACT

Partial differential equations that are used in describing the nonlinear heat and mass transfer phenomena are difficult to be solved. For the case where the exact solution is difficult to be obtained, it is necessary to use a numerical procedure such as the finite difference method to solve a particular partial differential equation. In term of numerical procedure, a particular method can be considered as an efficient method if the method can give an approximate solution within the specified error with the least computational complexity. Throughout this paper, the two-dimensional Porous Medium Equation (2D PME) is discretized by using the implicit finite difference scheme to construct the corresponding approximation equation. Then this approximation equation yields a large-sized and sparse nonlinear system. By using the Newton method to linearize the nonlinear system, this paper deals with the application of the Four-Point Newton-EGSOR (4NEGSOR) iterative method for solving the 2D PMEs. In addition to that, the efficiency of the 4NEGSOR iterative method is studied by solving three examples of the problems. Based on the comparative analysis, the Newton-Gauss-Seidel (NGS) and the Newton-SOR (NSOR) iterative methods are also considered. The numerical findings show that the 4NEGSOR method is superior to the NGS and the NSOR methods in terms of the number of iterations to get the converged solutions, the time of computation and the maximum absolute errors produced by the methods.