A newton-modified weighted arithmetic mean solution of nonlinear porous medium type equations

ABSTRACT

The mathematical theory behind the porous medium type equation is well developed and produces many applications to the real world. The research and development of the fractional nonlinear porous medium models also progressed significantly in recent years. An efficient numerical method to solve porous medium models needs to be investigated so that the symmetry of the designed method can be extended to future fractional porous medium models. This paper contributes a new numerical method called Newton-Modified Weighted Arithmetic Mean (Newton-MOWAM). The solution of the porous medium type equation is approximated by using a finite difference method. Then, the Newton method is applied as a linearization approach to solving the system of nonlinear equations. As the system to be solved is large, high computational complexity is regulated by the MOWAM iterative method. Newton-MOWAM is formulated technically based on the matrix structure of the system. Some initial-boundary value problems with a different type of nonlinear diffusion term are presented. As a result, the Newton-MOWAM showed a significant improvement in the computation efficiency compared to the developed standard Weighted Arithmetic Mean iterative method. The analysis of efficiency, measured by the reduced number of iterations and computation time, is reported along with the convergence analysis.