

An Efficient Backward Semi-Lagrangian Scheme for Nonlinear Advection-Diffusion Equation

Authors : Soyoon Bak, Sunyoung Bu, Philsu Kim

Abstract : In this paper, a backward semi-Lagrangian scheme combined with the second-order backward difference formula is designed to calculate the numerical solutions of nonlinear advection-diffusion equations. The primary aims of this paper are to remove any iteration process and to get an efficient algorithm with the convergence order of accuracy 2 in time. In order to achieve these objects, we use the second-order central finite difference and the B-spline approximations of degree 2 and 3 in order to approximate the diffusion term and the spatial discretization, respectively. For the temporal discretization, the second order backward difference formula is applied. To calculate the numerical solution of the starting point of the characteristic curves, we use the error correction methodology developed by the authors recently. The proposed algorithm turns out to be completely iteration-free, which resolves the main weakness of the conventional backward semi-Lagrangian method. Also, the adaptability of the proposed method is indicated by numerical simulations for Burgers' equations. Throughout these numerical simulations, it is shown that the numerical results are in good agreement with the analytic solution and the present scheme offer better accuracy in comparison with other existing numerical schemes. Semi-Lagrangian method, iteration-free method, nonlinear advection-diffusion equation, second-order backward difference formula

Keywords : Semi-Lagrangian method, iteration free method, nonlinear advection-diffusion equation, second-order backward difference formula

Conference Title : ICPPAM 2014 : International Conference on Parallel Processing and Applied Mathematics

Conference Location : Kuala Lumpur, Malaysia

Conference Dates : August 25-26, 2014