On the Trivariate Spectral Collocation Method of Solution for Two Dimensional Partial Differential Equations arising in Fluid Mechanics

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Abstract

In this study we introduce the multi-domain Trivariate spectral collocation method for solving nonlinear parabolic partial differential equations that are defined over large time intervals. The main idea is to reduce the size of the computational domain at each subinterval to ensure that very accurate resultsareobtainedwithinshortercomputationaltimewhenthespectralcollocation method is applied. The proposed method is based on applying the quasilinearization technique to simplify the nonlinear partial differential equation (PDE) first. The time domain is decomposed into smaller non-overlapping subintervals. Discretization is then performed on both time and space variables using spectral collocation. The approximate solution of the PDE is obtained by solving the resulting linear matrix system at each subinterval independently. When the solution in the first subinterval has been computed, the continuity condition is used to obtain the initial guess in subsequent subintervals. The solutions at different subintervals are matched together along a common boundary. The examples chosen for numerical experimentation include, the system equations governing Numerical solution of the Transient Free Convection in Magneto-Micro polar Fluid past vertical semi-infinite porous plate with Heat Generation, Mass Transfer and Constant Heat Flux subjected to variable Magnetic Field. To demonstrate the accuracy and the effectiveness of the proposed method, the condition number and the error analysis of the system is presented in graphs and tables.

Keywords –Discretization, multi-domain, nonlinear, Quasilinearization, Spectral Collocation

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