Abstract No: 201 ***ICT, Mathematics, and Statistics***

METHOD OF DIRECTLY DEFINING INVERSE MAPPING FOR CAUCHY REACTION-DIFFUSION PROBLEMS

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Perturbation and asymptotic techniques were widely used by researchers to obtain analytical approximations for nonlinear problems, which often fail when nonlinearity is strong. The Homotopy Analysis Method (HAM) was suggested to solve higher nonlinear problems. The HAM works independently of physical parameters and ensures the convergence of solution series. While the HAM offers great flexibility in selecting base functions, initial guesses, and linear operators, it also requires substantial time to compute the inverse linear operators for differential equations. The Method of Directly Defining inverse Mapping (MDDiM) was introduced to overcome this difficulty. The MDDiM offers the freedom to select the inverse linear mapping directly. In this study, an approximation series solution of the time-dependent reaction-diffusion problems was obtained by extending and applying MDDiM. Reaction-diffusion equations are used to describe nonlinear systems in fields such as physics, chemistry, ecology, biology, and engineering. Since the direct definition of the inverse operator, series solutions have been obtained with less CPU time, minimal errors, and simplified terms. The proposed method achieved a remarkable level of accuracy, with solutions falling within an error range of 10^{-5} to 10^{-10}, with five iterations. Therefore, it can be concluded that MDDiM is convenient and accurate.

Keywords: Cauchy reaction-diffusion problems, Homotopy analysis method, Method of Directly Defining inverse Mapping