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Modified variational iteration algorithm-II: convergence and applications to diffusion models. (English) Zbl 1453.65377

Summary: Variational iteration method has been extensively employed to deal with linear and nonlinear differential equations of integer and fractional order. The key property of the technique is its ability and flexibility to investigate linear and nonlinear models conveniently and accurately. The current study presents an improved algorithm to the variational iteration algorithm-II (VIA-II) for the numerical treatment of diffusion as well as convection-diffusion equations. This newly introduced modification is termed as the modified variational iteration algorithm-II (MVIA-II). The convergence of the MVIA-II is studied in the case of solving nonlinear equations. The main advantage of the MVIA-II improvement is an auxiliary parameter which makes sure a fast convergence of the standard VIA-II iteration algorithm. In order to verify the stability, accuracy, and computational speed of the method, the obtained solutions are compared numerically and graphically with the exact ones as well as with the results obtained by the previously proposed compact finite difference method and second kind Chebyshev wavelets. The comparison revealed that the modified version yields accurate results, converges rapidly, and offers better robustness in comparison with other methods used in the literature. Moreover, the basic idea depicted in this study is relied upon the possibility of the MVIA-II being utilized to handle nonlinear differential equations that arise in different fields of physical and biological sciences. A strong motivation for such applications is the fact that any discretization, transformation, or any assumptions are not required for this proposed algorithm in finding appropriate numerical solutions.

MSC:
65M09 Numerical methods for partial differential equations, initial value and time-dependent initial-boundary value problems
65M06 Finite difference methods for initial value and initial-boundary value problems involving PDEs

Full Text: DOI

References:


He, J.-H.; Wu, G.-C.; Austin, F., The variational iteration method which should be followed, Nonlinear Science Letters A, 1, 1, 30 (2010)


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