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Contents

Homotopy Analysis Method For Oscillatory Systems With Cubic and Trigonometric Non-Linearity

Sumit J. Patil, Anisha R.V. Kashyap, and Kiran M. Kolwankar

Abstract Analytical solutions to nonlinear oscillating systems cannot be represented without the help of special functions or they can be studied only using numerical techniques. We have studied an oscillating system which has a linear term, as well as a cubic and a trigonometric nonlinearity all at once. Approximate solutions to such nonlinear problems can be given using perturbation and decomposition techniques provided that the nonlinearity is small or perturbation is small enough. We have applied a promising technique of Homotopy Analysis which works even in the case of large nonlinearity in the system. Using this method, we have successfully obtained the approximate analytical solution to this system (with cubic and trigonometric nonlinearity) which fits numerical solution for several cycles of oscillations unlike perturbation and Adomian decomposition method which provide solutions that barely fit for more than a half cycle. Some of the implicit difficulties in handling two different kinds of nonlinearities in a single system were overcome by using a simple technique of representing nonlinear terms using their Maclaurin expansion truncated to the required order of precision so that all the terms now are polynomial in nature. In this way, it has been shown that the nonlinearity thus represented can be effectively and far more easily handled using Homotopy Analysis Method. The approximate analytical results of three different techniques and their comparison for this nonlinear oscillating system has been made thoroughly with respect to computations and accuracy.

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