Adomian Decomposition Method for

First Order Partial Differential Equations

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Abstract

Adomian decomposition method is a very powerful technique to solve nonlinear problems, including ordinary differential equations, partial differential equations, differential-algebraic equations, differential-difference equations, integro-differential equations, stochastic systems and eigenvalue problems, etc. It is well known in literature that this method gets the rapidly convergent series solution and is a typical semi-analytic method. For certain problems it even becomes an analytic method that captures exact solution.

We apply this method to solve many first order partial differential equations, including linear and nonlinear, smooth and nonsmooth initial/boundary conditions. It has the speed of exponential convergence, which is faster than classical methods like finite difference and finite element. Sometime it can even reach super-geometric convergence. Moreover, it can solve problems with parameters, where normal numerical methods fail. Our computing experiments show it is far more accurate, reliable and efficient than existing traditional methods.

Keywords: Adomian decomposition, semi-analytic method, nonlinearity, first order partial differential equation, exponential convergence, super-geometric convergence