The Modified Simple Equation Method for Solving Some Nonlinear Evolution Equations

M.Mızrak and A.Ertaş
Department of Mathematics, Dicle University, Diyarbakır, Turkey

Abstract

In this paper we applied modified simple equation method (MSEM) for solving some nonlinear evolution equations which are very important in applied sciences.

We consider a nonlinear evolution equation:

$$F\left(u,u_t,u_x,u_{xx},...\right)=0 \tag{1}$$

where F is a polynomial in u and its partial derivatives.

Step 1. Using the wave transformation

$$u=u\left(\xi\right),\ \xi=x-t \tag{2}$$

From (1) and (2) we have the following ODE:

$$P\left(u,u',u'',u''',...\right)=0 \tag{3}$$

where P is a polynomial in u and its total derivatives and $'=\frac{d}{d\xi}$.

Step 2. We suppose that Eq. (3) has the formal solution:

$$u\left(\xi\right)=\sum_{k=0}^{N}A_k\left(\frac{\psi'\left(\xi\right)}{\psi\left(\xi\right)}\right)^k \tag{4}$$

where A_k are arbitrary constants to be determined such that $A_N\neq 0$ while $\psi\left(\xi\right)$ is an unknown function to be determined later.

Step 3. We determine the positive integer N in (4) by balancing the highest order derivatives and the nonlinear terms in Eq. (3).

Step 4. We substitute (4) into (3), we calculate all the necessary derivatives $u',u'',...$ and then we account the function $\psi\left(\xi\right)$. As a result of this substitution, we get a polynomial of $\frac{\psi'\left(\xi\right)}{\psi\left(\xi\right)}$ and its derivatives. In this polynomial, we equate with zero all the coefficients of it. This operation

yields a system of equations which can be solved to find A_k and $\psi(\xi)$. Consequently, we can get the exact solution of Eq. (1).

References

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