

Letter to the Editor

An Aproximation to Solution of Space and Time Fractional Telegraph Equations by the Variational Iteration Method

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Received 23 August 2012; Accepted 1 September 2012

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Sevimlican suggested an effective algorithm for space and time fractional telegraph equations by the variational iteration method. This paper shows that algorithm can be updated by either variational iteration algorithm-II or the fractional variational iteration method.

As early as 1998, the variational iteration method was shown to be an effective tool for factional calculus [1]; afterwards, the method has been routinely used to solve various fractional differential equations for many years, see the review article in [2] for a detailed summarization. Sevimlican [3] also followed the solution given in [1]; however, the algorithm can be further improved.

Sevimlican considered the following one-dimensional space fractional telegraph equation:

$$\frac{\partial^\alpha u}{\partial x^\alpha} = \frac{\partial^2 u}{\partial t^2} + \frac{\partial u}{\partial t} + u, \quad 1 < \alpha < 2, \quad (1)$$

and obtained the following iteration formulation:

$$u_{n+1}(x, t) = u_n(x, t) + \int_0^x (s-x) \left\{ \frac{\partial^\alpha u_n(s, t)}{\partial s^\alpha} - \frac{\partial^2 u_n(s, t)}{\partial s^2} - \frac{\partial u_n(s, t)}{\partial s} - u_n(s, t) \right\} ds. \quad (2)$$

We can also construct a correction functional in the form

$$u_{n+1}(x, t) = u_n(x, t) + \int_0^x \lambda \left\{ \frac{\partial^\alpha \tilde{u}_n(s, t)}{\partial s^\alpha} - \frac{\partial^2 u_n(s, t)}{\partial s^2} - \frac{\partial \tilde{u}_n(s, t)}{\partial s} - \tilde{u}_n(s, t) \right\} ds. \quad (3)$$

If the multiplier λ can be exactly identified, then one iteration results in the exact solution; however, the exact identification of the multiplier is impossible for most problems, and an approximate identification is always followed. To this end, \tilde{u}_n in (3) is assumed to be a known function, and it is generally called a restricted variable [4]. After identification of the multiplier, we obtain the following variational iteration Algorithm-II [5]:

$$u_{n+1}(x, t) = u_0(x, t) - \int_0^x (s-x) \left\{ \frac{\partial^\alpha u_n(s, t)}{\partial s^\alpha} - \frac{\partial u_n(s, t)}{\partial s} - u_n(s, t) \right\} ds \quad (4)$$

If we begin with $u_0(x, t) = u_0(0, t) + xu_x(0, t)$, (4) leads to the same result as given in [3].

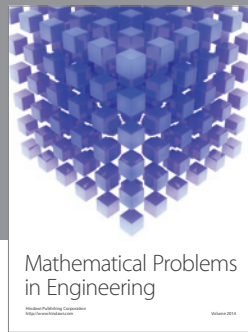
The fractional variational iteration method is also suitable for the present problem, see the solution process in [5–7].

Acknowledgment

The work is a project funded by PAPD (The Priority Academic Program Development of Jiangsu Higher Education Institutions).

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