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Variable separation method for a nonlinear time fractional partial differential equation with forcing term

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Abstract

In this paper, a variable-coefficient nonlinear time fractional partial differential equation (PDE) with initial and boundary conditions is solved by using the variable separation method. As a result, some new explicit and exact solutions of the time fractional PDE are obtained including Airy function solution, hyperbolic function solution, trigonometric function solution and rational solution. It is shown that the variable separation method can provide a useful mathematical tool for solving some other nonlinear time fractional PDEs in science and engineering.

Keywords:
Variable separation method; time fractional PDE; Airy function solution; hyperbolic function solution; trigonometric function solution; rational solution

1. Introduction

As the generalization of classical differential equations with integer order, fractional differential equations (FDEs) play significant role in successfully describing many phenomena in engineering, physics, chemistry, economics and other fields. One of the most important FDEs often used in engineering is the fractional advection-diffusion equation [1]. Recently, fractional differential calculus and its applications have attracted much attentions [2–20]. In 2010, Fujioka, Espinosa and Rodríguez [12] described soliton propagation of an extended nonlinear Schrödinger equation which incorporates fractional dispersion and a fractional nonlinearity. In 2014, Yang, Hristov, Srivastava

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