

量子物理

构造非线性演化方程精确解的一个新方法

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摘要:

基于辅助方程提出一种求解非线性演化方程的一个新方法, 该方法简单易行且具有一定的普适性, 根据不同的参数可给出各种形式的精确解, 从而有助于探索非线性方程的新解及其性质。并以mkdv方程为例, 得到了其多组精确解, 包括Jacobi椭圆函数解及Weierstrass椭圆函数解等, 除涵盖了以往结果, 还给出一些新解。

关键词: 非线性方程 精确解 辅助方程 mkdv方程

A new algebra method for constructing exact solutions of nonlinear evolution equations

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Abstract:

A new algebra method for constructing exact solutions of nonlinear evolution equations is proposed based on the auxiliary equation; the method is simple and universal. It can give various types of exact solutions according to different parameters, which will be helpful to seek more new exact solutions and explore properties of nonlinear evolution equations. As an application, many kinds of explicit solutions including Jacobi and Weierstrass elliptic function solutions etc are obtained, some of which are new.

Keywords: nonlinear equation exact solution auxiliary equation mkdv equation

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参考文献:

- [1] Wang Mingliang. Solitary wave solutions for variant Boussinesq equations [J]. Phys. Lett. A, 1995, 199: 169-172.
- [2] Sun Jian, Narenmandula. Multiple solitary wave solutions of variable coefficient forced Burgers equation and interaction of solitary waves[J]. Chinese Journal of Quantum Electronics(量子电子学报), 2011, 28(1):31-36(in Chinese).
- [3] Guo Peng, Zhang Lei, Wang Xiaoyun, Sun Xiaowei. Explicit and exact solutions to the mBBM and Vakhnenko equations[J]. Chinese Journal of Quantum Electronics(量子电子学报), 2010, 27(6):683-687 (in Chinese).
- [4] Zheng Bin. New soliton solutions to (2+1) dimensional breaking soliton equation [J]. Chinese Journal of Quantum Electronics (量子电子学报), 2006,23(4):451-455(in Chinese).
- [5] Tian Guichen, Liu Xiqiang. Exact solutions of the general variable coefficients Kdv equation with external force term [J]. Chinese Journal of Quantum Electronics(量子电子学报), 2005,22(3):339-343(in Chinese).
- [6] Yan Chuntao. A simple transformation for nonlinear waves [J]. Phys. Lett. A . 1996,224: 77-84.

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- [7] Li Zhibin, Yao Ruoxia Explicit exact solutions coupled differential equations [J]. Acta Phys. Sin(物理学报), 2001,50(11): 2062-2066 (in Chinese).
- [8] Taogetusang, Sirendaoerji. New solitary wave solutions of the combined Kdv equation with variable coefficients [J]. Chinese Journal of Quantum Electronics(量子电子学报), 2009,26(2):148-154(in Chinese).
- [9] Xu Guiqiong, Li Zhibin. Solitary wave solutions of a nonlinear evolution equation using mexed exponential method[J]. Acta Phys Sin (物理学报),2002, 51: 946-950 (in Chinese).
- [10] Xu Guiqiong, Li Zhibin. Extended mixing exponential method and its applications Acta Phys Si (物理学报) 2002,51: 1424-1427 (in Chinese).
- [11] Taogetusang, Sirendaoerji. Jacobi-like elliptic function exact solutions of (3+1) dimensional Z-Kequation [J]. Chinese Journal of Quantum Electronics(量子电子学报), 2010,27(1):6-14(in Chinese).
- [12] Liu Shikuo, Fu Zuntao, Liu Shida, Zhao Qiang. Jacobi elliptic function expansion method and periodic wave solutions of nonlinear wave equations[J]. Phys . Lett . A , 2001,289: 69-74.
- [13] Fan Engui. Uniformly constructing a series of explicit exact solutions to nonlinear equations in mathematical physics [J]. Chaos Solitons Fractals, 2003 ,16: 819-839.
- [14] Yan Zhenya. An improved algebra method and its applications in nonlinear wave equations[J]. Chaos Solitons Fractal,2004, 21: 1013-1021.
- [15] Liu Yinping, Li Zhibin. An automated algebraic method for finding a series of exact travelling wave solutions of nonlinear evolution equations[J]. Chin. Phys.Lett, 2003,20: 317-320.
- [16] Fu Zuntao. New kinds of solutions to Gardner equation[J]. Phys. Lett. A, 2004, 20: 301-309.
- [17] Liu Shikuo, Liu Shida. Nonlinear Equations in Physics[M]. Peking University Press, 2000.
- [18] Fu Zuntao, Liu Shikuo, Liu Shida, Zhao Qiang. New Jacobi elliptic function expansion and new periodic solutions of nonlinear wave equations[J]. Phys. Lett. A, 2001, 290: 72-76.
- [19] Fu Zuntao, Liu Shikuo, Liu Shida. New transformations and new approach to find exact solutions to nonlinear equations[J]. Phys. Lett. A ,2002,299: 507-512.

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4. 郭鹏 张磊 王小云 孙小伟.mBBM方程和Vakhneoko方程的显式精确解[J]. 量子电子学报, 2010,27(6): 683-687
5. 涂杰 胡连 .脉冲宽度对绝热演化下制备纠缠态的影响[J]. 量子电子学报, 2010,27(3): 300-307
6. 孙健 那仁满都拉.变系数强迫Burgers方程的多孤立波解及孤立波的相互作用[J]. 量子电子学报, 2011,28(1): 31-36
7. 套格图桑 斯仁道尔吉.(2+1)维色散长波方程组新的无穷序列精确解[J]. 量子电子学报, 2010,27(4): 402-410
8. 王婷婷 刘希强 于金倩.Caudrey-Dodd-Gibbon-Kotera-Sawada方程的对称、精确解和守恒律[J]. 量子电子学报, 2011,28(4): 385-390
9. 肖亚峰 薛海丽 张鸿庆.立方非线性薛定谔方程的新多级包络周期解[J]. 量子电子学报, 2012,29(3): 269-278
10. 韩元春 额尔敦仓 那仁满都拉.变系数(2+1)维Burgers系统的精确解及特殊孤波结构[J]. 量子电子学报, 2012,29(3): 286-291
11. 庞晶 靳玲花 应孝梅.利用(G'/G)展开法求解广义变系数Burgers方程[J]. 量子电子学报, 2011,28(6): 674-681
12. 陈美, 刘希强, 王猛.对称正则长波方程组的对称,精确解和守恒律[J]. 量子电子学报, 2012,29(1): 21-26
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