РУХАНИ ЖАҢҒЫРУ

20 АСТАНА

ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың
«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

СБОРНИК МАТЕРИАЛОВ

XIII Международная научная конференция
студентов и молодых ученых
«НАУКА И ОБРАЗОВАНИЕ - 2018»

The XIII International Scientific Conference
for Students and Young Scientists
«SCIENCE AND EDUCATION - 2018»

12th April 2018, Astana

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
Л.Н. ГУМИЛЕВ АТЫНДАҒЫ ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың «Ғылым және білім - 2018» атты XIII Халықаралық ғылыми конференциясының БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ XIII Международной научной конференции студентов и молодых ученых «Наука и образование - 2018»

PROCEEDINGS of the XIII International Scientific Conference for students and young scholars «Science and education - 2018»

2018 жыл 12 сәуір

Астана

УДК 378

ББК 74.58
Ғ 96

Ғ 96
«Ғылым және білім – 2018» атты студенттер мен жас ғалымдардың XIII Халықаралық ғылыми конференциясы = XIII Международная научная конференция студентов и молодых ученых «Наука и образование - 2018» = The XIII International Scientific Conference for students and young scholars «Science and education - 2018». – Астана: http://www.enu.kz/ru/nauka/nauka-i-obrazovanie/, 2018. – 7513 стр. (қазақша, орысша, ағылшынша).

ISBN 978-9965-31-997-6

Жинаққа студенттердің, магистранттардың, докторанттардың және жас ғалымдардың жаратылыстану-техникалық және гуманитарлық ғылымдардың өзекті мәселелері бойынша баяндамалары енгізілген.

The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

УДК 378

ББК 74.58

ISBN 978-9965-31-997-6

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UDC 517.957, 532.5

EXTENDED HYPERBOLIC TANGENT METHOD FOR GARDNER EQUATION

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Introduction. In this paper, we consider the Gardner equation in the following view [1]

$$\begin{cases} u_t = (\beta \cdot \omega - \frac{\beta^2}{2} \cdot u^2 + \delta \cdot u) \cdot u_x + \omega_y + \varepsilon^2 u_{xxx} \\ u_y - \omega_x = 0 \end{cases}, \quad (1)$$

where $u(t,x,y)$ represents the fluid velocity in the horizontal direction x and in the vertical direction y, $\beta, \delta, \varepsilon$ are positive constants.

The aim of the paper is to obtain new kind of solutions for the Gardner equation based on extended tanh method [2-4], and with the help of Maple.

Extended hyperbolic tangent method for Gardner equation. Consider the Gardner equation (1). We convert equation (1) to an ordinary differential equation

$$-cu' - \beta uu' + \frac{\beta^2}{2} u^2 u' - \delta uu' - u' - \varepsilon^2 u''' = 0, \quad (2a)$$
$$u' - \omega' = 0. \quad (2b)$$

After we integrate equation (2) until all terms have derivatives

$$\beta^2 u^3 - u^2(3\beta + 3\delta) - 6u - 6cu - 6\varepsilon^2 u'' = 0 \quad (3a)$$
$$u = \omega. \quad (3b)$$

Balancing $u^3$and u'' in the equation (3a) gives $3M = M + 2$. So that $M = 1$.The extended tanh method admits the use if the finite expansion

$$u(x,t) = a_0 + a_1 Y + a_2 Y^2 + b_1 Y^{-1} + b_2 Y^{-2}. \quad (4)$$

Substituting (4) into (3), and collecting the coefficients of Y ,we obtain a system of algebraic equations for $a_0, a_1, a_2, b_1, b_2, \mu$

$$Y^3 : a_1^3 \beta^2 - 12 a_1 \mu^2 \varepsilon^2 = 0, \quad (5a)$$

$$Y^2 : 3 a_0 a_1^2 \beta^2 - 3 a_1^2 \beta - 3 a_1^2 \delta = 0, \quad (5b)$$

$$Y : 3 a_0^2 a_1 \beta^2 + 3 a_1^2 b_1 \beta^2 + 12 a_1 \mu^2 \varepsilon^2 - 6 a_0 a_1 \beta - 6 a_0 a_1 \delta - 6 a_1 c - 6 a_1 = 0, \quad (5c)$$

$$Y^0: a_0^3\beta^2 + 6\beta^2 a_0 a_1 b_1 - 3{a_0}^2\beta - 3{a_0}^2\delta - 6a_1 b_1\beta - 6a_1 b_1\delta - \\ -6ca_0 - 6a_0 = 0, \quad (5d)$$

$$Y^{-1}: 3a_0^2 b_1\beta^2 + 3a_1{b_1}^2\beta^2 + 12b_1\mu^2\varepsilon^2 - 6a_0 b_1\beta - 6a_0 b_1\delta - 6b_1 c - 6b_1 = 0, \quad (5e)$$

$$Y^{-2}: 3a_0 b_1^2\beta^2 - 3b_1^2\beta - 3b_1^2\delta = 0, \quad (5f)$$

$$Y^{-3}: b_1^3\beta^2 - 12b_1\mu^2\varepsilon^2 = 0 \quad (5g)$$

Solving system (5) with the aid of Maple, we obtain the following results

Result 1:
Coefficients:

$$a_0 = \frac{\beta+\delta}{\beta^2}, a_1 = \pm\frac{\frac{1}{2}I(\beta+\delta)\sqrt{2}}{\beta^2}, b_1 = \pm\frac{\frac{1}{2}I(\beta+\delta)\sqrt{2}}{\beta^2}, \mu = \pm\frac{\frac{1}{12}I(\beta+\delta)\sqrt{6}}{\beta\varepsilon}, c = -\frac{1}{3}\frac{4\beta^2+2\beta\delta+\delta^2}{\beta^2} \quad (6)$$

Substituting (6) in (4), we obtain the following solution:

$$u_1 = 1 - \frac{1}{2}\sqrt{2}\tanh\left(\frac{1}{6}\sqrt{6}\left(x+y+\frac{7}{3}\right)\right) + \frac{1}{2}\frac{\sqrt{2}}{\tanh\left(\frac{1}{6}\sqrt{6}\left(x+y+\frac{7}{3}\right)\right)} \quad (7)$$

The graphical representation of solution (7) is depicted in Figure 1.

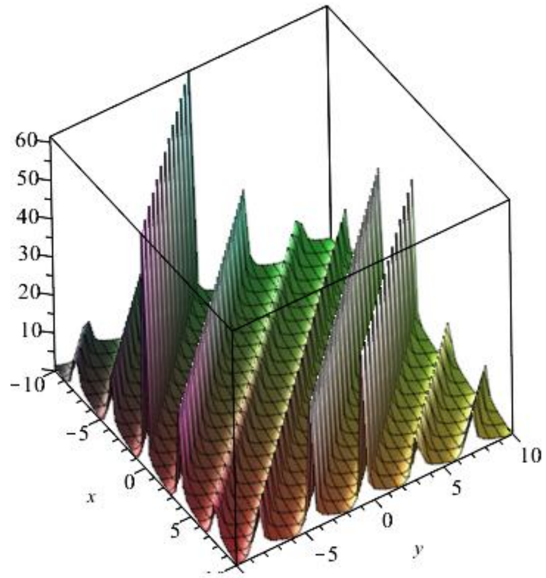

Figure - 1 The solution $\boldsymbol{u_1(x,t)}$ of equation (1).

Result 2:
Coefficients:

$$a_0 = \frac{\beta+\delta}{\beta^2}, a_1 = -\frac{\beta+\delta}{\beta^2}, \ b_1 = 0, \mu = \pm\frac{1}{6}\frac{(\beta+\delta)\sqrt{3}}{\beta\varepsilon}, c = -\frac{1}{3}\frac{4\beta^2+2\beta\delta+\delta^2}{\beta^2} \quad (8)$$

Substituting (8) in (4), we obtain the following solution:

$$u_2 = 1 - \tanh\left(\frac{1}{3}\sqrt{3}\left(x + y + \frac{7}{3}\right)\right) \quad (9)$$

The graphical representation of solution (9) is depicted in Figure 2.

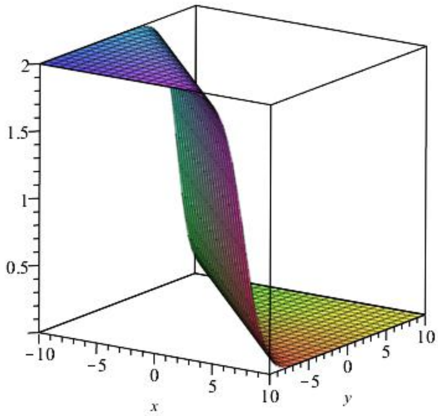

Figure - 2 The solution $\boldsymbol{u_2(x,t)}$ of equation (1).

Conclusion. In this paper, we studied the Gardner equations. Using the extended tanh method, we have constructed various exact wave solutions for this equation. The graphical representation of the obtained solutions is presented in the figures.

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UDC532.5;519.95

ONE SOLITON SOLUTION OF THE (2+1) – DIMENSIONAL REVERSE TIME COMPLEX MODIFIED KORTEWEG-DE VRIES EQUATIONS

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Introduction. The KdV equation

$$q_t + 6qq_x + q_{xxx} = 0, \quad (1)$$

and the mKdV equation

$$q_t + 6q^2 q_x + q_{xxx} = 0, \quad (2)$$