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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ТҰҢҒЫШ ПРЕЗИДЕНТІ - ЕЛБАСЫНЫҢ ҚОРЫ

«ҒЫЛЫМ ЖӘНЕ БІЛІМ – 2017»
студенттер мен жас ғалымдардың
XII Халықаралық ғылыми конференциясының
БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ
XII Международной научной конференции
студентов и молодых ученых
«НАУКА И ОБРАЗОВАНИЕ – 2017»

PROCEEDINGS
of the XII International Scientific Conference
for students and young scholars
«SCIENCE AND EDUCATION - 2017»

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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.

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NONLINEAR WAVES FOR THE KORTEWEG-DE VRIES EQUATION

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1. Introduction. The KdV equation in dimensionless variables reads [1]

$$U_t \pm 6UU_x + U_{xxx} = 0. \tag{1}$$

This equation models a variety of nonlinear wave phenomena such as shallow water waves, acoustic waves in a harmonic crystal, and ion-acoustic waves in plasmas. The KdV equation is completely integrable and gives rise to multiple-soliton solutions. This equation has been studied by a variety of methods such as the inverse scattering method, Hitota method, the Bäcklund transformation method [2]. The KdV equation admits multiple soliton solutions and exhibits an infinite number of conservation laws of energy [1, 2].

2. Soliton and periodic solutions. We will study the KdV equation, given in the form

$$U_t + U_{xxx} + 6UU_x = 0. \tag{2}$$

The aim of this research article is to construct nonlinear wave solutions for equation (2) using the methods: tanh, coth, tan, cot [3].

2.1 Using the tanh and the coth method. Using the tanh method, which is well known in the literature, we set the solution in the form

$$U(x,t) = a_0 + a_1 \tanh^2(kx - ct). \tag{3}$$

Substituting this assumption in (2), and setting the coefficients of $tanh^j(kx - ct)$, j=5,3,1 to zero, we obtain

$$\begin{gathered} 12a_1^2k + 24a_1k^3 = 0, \\ 12a_0a_1k - 12a_1^2k - 2a_1c - 40a_1k^3 = 0, \\ -12a_0a_1k + 2a_1c + 16a_1k^3 = 0. \end{gathered} \tag{4}$$

Solving this system gives

$$\begin{gathered} a_0 = \frac{c + 8k^3}{6k}, \\ a_1 = -2k^2, \end{gathered} \tag{5}$$

which gives the soliton solution

$$U(x,t) = \frac{c+8k^3}{6k} - 2k^2 \tanh^2(kx-ct), \quad (6)$$

where *k* and *c* are left the as free parameters. The graphical representation of the soliton solution (6) for the equation (2) is shown in Fig. 1.

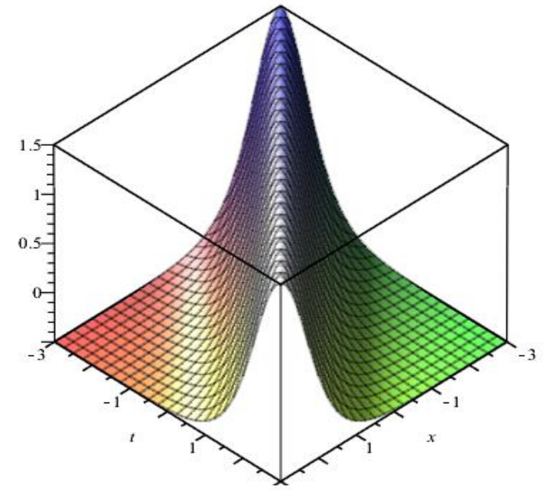

Figure 1: k=1, c=1, -3≤x≤3, -3≤t≤3.

However, by using the coth method, we set the solution in the form

$$U(x,t) = a_0 + a_1 \coth^2(kx-ct). \quad (7)$$

Proceeding as before, we obtain the singular soliton solution

$$U(x,t) = \frac{c+8k^3}{6k} - 2k^2 \coth^2(kx-ct), \quad (8)$$

where *k* and *c* are left the as free parameters. The graphical representation of the soliton solution (8) for the equation (2) is shown in Fig. 2.

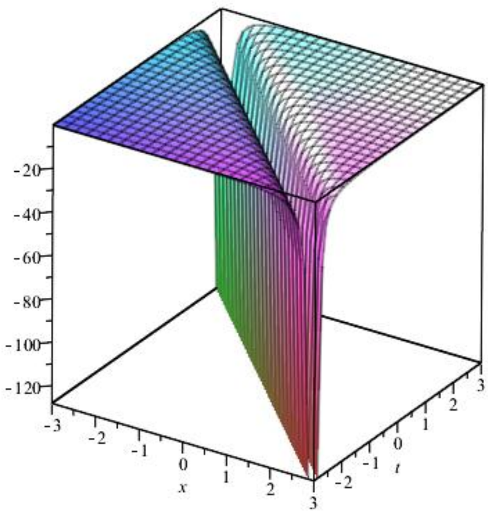

Figure 2: k=-0.1, c=0.1, -3≤x≤3, -3≤t≤3.

2.2 Using the tan and the cos method. The tan ansatz admits the use of the solution in the form

$$U(x,t) = a_0 + a_1 \tan^2(kx - ct). \tag{9}$$

Substituting this assumption in (2), and setting the coefficient of $tan^j(kx - ct)$, j=5,3,1 to zero, we obtain

$$\begin{aligned} &12a_1^2 k + 24a_1 k^3 = 0,\\ &12a_0 a_1 k - 12a_1^2 k - 2a_1 c - 40a_1 k^3 = 0, \\ &-12a_0 a_1 k + 2a_1 c + 16a_1 k^3 = 0. \end{aligned} \tag{10}$$

Solving this system gives

$$\begin{aligned} a_0 &= \frac{c + 8k^3}{6k},\\ a_1 &= -2k^2, \end{aligned} \tag{11}$$

which gives the periodic solution

$$U(x,t) = \frac{c + 8k^3}{6k} - 2k^2 \tan^2(kx - ct), \tag{12}$$

where k and c are left the as free parameters. The graphical representation of the periodic solution (12) for the equation (2) is shown in Fig. 3.

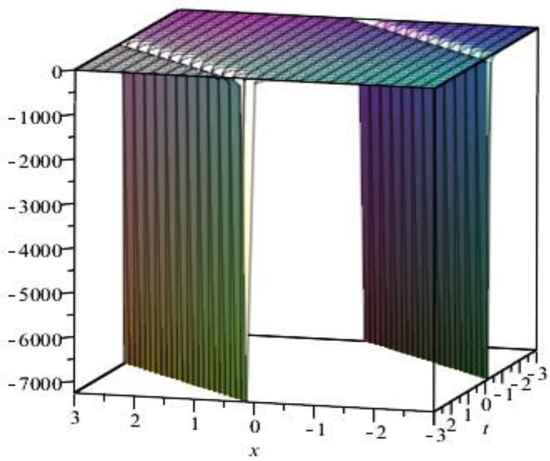

Figure 3:k=-0.5, c=0.5, -3≤x≤3, -3≤t≤3.

However, by using the cot ansatz, we set the solution in the form

$$U(x,t) = a_0 + a_1 \cot^2(kx - ct). \tag{13}$$

Proceeding as before, we obtain the next solution

$$U(x,t) = \frac{c+8k^3}{6k} - 2k^2 \cot^2(kx-ct), \qquad (14)$$

where k and c are left the as free parameters. The graphical representation of the solution (14) of the equation (2) is shown in Fig. 4.

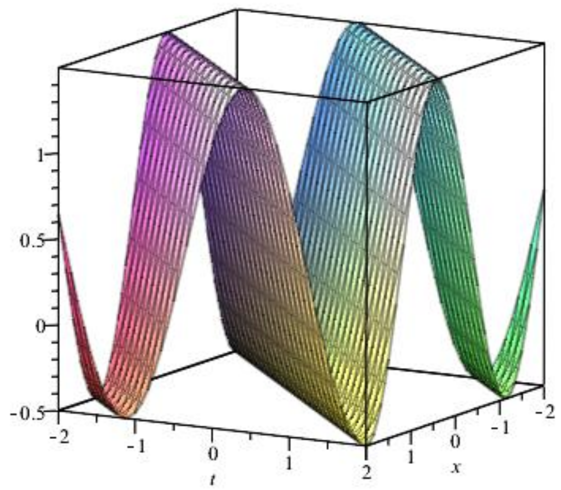

Figure 4:k=1, c=1, -2≤x≤2, -2≤t≤2.

Conclusion. In this paper, we examined the nonlinear the Korteweg-de Vries equation. Using the methods tanh, coth, tan, cot, 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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FIRST AND SECOND FUNDAMENTAL FORMS OF (1+1)- DIMENSIONAL MAXWELL AND BLOCH EQUATIONS

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1. Introduction

Lax representation is not just a tool to derive the exact solutions of corresponding equations, also can be the geometry object to find geometrical aspects of the equations [1]. In this paper, we show the first and second fundamental forms of the (1+1)-dimensional Maxwell and Bloch equations by using the Lax representation.