COMMENTARY

NLE's solitary wave solutions are of great importance in nonlinear theory

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ABSTRACT

The (3 + 1) dimensional equation of Wazwaz Benjamin Bona Mahony [(3 + 1) dimension WBBM] using Sardar's sub-equation method. When the parameters involved in this approach are treated as special values, we can get Solitary Wave Solutions (SWS) inferred from other approaches such as the functional variable method the drag equation, the first integral method, etc. We thus obtained new and generalized solitary wave solutions of generalized trigonometric and hyperbolic functions. The results demonstrate the power of the proposed method to determine the sws of Non-Linear Evolution (NLE) equations.

COMMENTARY

Exact solutions and solitary wave solutions of NLEs have a high importance in nonlinearity theory. It is a well-known fact that numerous complex events in various fields of engineering application and nonlinear science such as chemistry, mathematical physics, mechanics, hydrodynamics, biology, cosmology, and mechanics are explained by NLEs. Exact solutions produce corporal information to describe the physical behaviour of system connected with these NLEs. In recent years, several efficient methods including method of extended tanh, tanhcoth, Hirota`s direct, sinecosine, extended direct algebraic, extended trial approach, Exp [φ(ξ)]Expansion, a new auxiliary equation, Jacobi elliptic ansatz, generalized Bernoulli subODE, functional variable, sub equation, and so on, have been established for efficient solutions of NLEs. In this paper, we utilize of an effective and efficient technique for manufacturing a range of solitary wave solutions for the variants of the (3+1) dimensional WBBM equations.

The Benjamin Bona Mahony (BBM) equation

$$u_t + u_x + uu_x - u_{xxt} = 0, \quad (1)$$

Proposed in as a model to study the approximately the unidirectional propagation of smallamplitude long waves on certain nonlinear dispersive systems as a good alternative to the KdV. It is used in modeling surface waves of long wavelength in liquids; it covers hyd–romagnetic waves in cold plasma, acoustic waves in anharmonic crystals, and acoustic gravity waves in compressible fluids. Many efforts have been offered to modified forms of this equation known such as

$$u + u + u^2 u - u = 0, \quad (2)$$

as modified Benjamin Bona Mahoney (mBBM) equation. Furthermore, as higher dimensional samples convert to be more realistic; various modifications to Equation (2) have been proposed in the literature among which the (3+1) dimensional mBBM equation given in Equations (3–5) by Wazwaz. Using the tanh/sech method, Wazwaz obtained soliton, kink, and periodic solutions for the following three different types of Equation (2)

$$u_t + u_x + u^2 u_y - u_{xzt} = 0, \quad (3)$$

$$u_t + u_z + u^2 u_x - u_{xyt} = 0, \quad (4)$$

And

$$u_t + u_y + u^2 u_z - u_{xxt} = 0. \quad (5)$$

Based on these ideas, this paper is organized as follows. Section the Sardar Sub equation Method introduces a brief description of the Sardar sub equation method. Section The (3+1) Dimensional WBBM Equation discusses the application of the Sardar sub equation method to variants of (3+1) dimensional WBBM equations represents by (3)–(5). The graphical presentation for the acquired solution is given in section Exact Solutions of the (3+1) Dimensional WBBM Equation. We complete the paper with conclusions part.

CONCLUSION

We have proposed a method, namely Sardar sub equation method to solve NLEs using Maple software. Distinct forms of the dimensional WBBM (3+1) equation are processed to show the efficiency of the propo-

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-ed method From our results, a number of sws are obtained, including the solutions of the general trigonometric and hyperbolic functions. To our knowledge, we describe and introduce Sardar's sub-equation method for the first time, a new method for solving NLE problems. Therefore, all the solutions of the distinct forms of the 3-dimensional WBBM equation (3+1) are new, which, to our knowledge, cannot be found in the literature. We can also see that the approach used in this letter is very effective, powerful and practical and can be applied frequently to the NLE. We will extend the proposed method to some fractional models in future work.