Applications of the Tanh Procedure to Nonlinear Differential Equations

Özge HAMZAOĞLU*[1], *Arzu AKBULUT

[1]*Department of Mathematics, Arts and Science Faculty, Bursa Uludağ University, Bursa, Türkiye*
Presenting author *e-mail address: ozgeehamzaoglu@gmail.com*
Orcid ID Özge HAMZAOĞLU: 0009-0003-8398-6142;
Orcid ID Arzu AKBULUT: 0000-0003-2448-2481

Abstract

In our study, the tanh method was considered and applied to a nonlinear partial differential equation that describes a physical phenomenon. By applying the method to the equation, two different solution families were obtained, and the solutions were expressed in terms of analytical solutions. By assigning values to the arbitrary constants in the obtained solutions, 3D, 2D, and projection graphs were plotted. The physical interpretation of the graphs was conducted, and comments were made regarding wave motions. As a result, it was observed that the proposed method is effective and suitable for finding solutions to the equation. Our findings are applicable in fields such as physics and engineering.

Keywords: *Tanh Procedure, Wave solutions, Exact Solutions, Nonlinear differential Equations*

[1] Wazwaz, A.. The tanh-coth method for solitons and kink solutions for nonlinear parabolic equations. Applied Mathematics and Computation, 2007, 188 , 1467-1475.

[2] Akbulut, A., Arnous, A. H., Hashemi, M. S., & Mirzazadeh, M.. Solitary waves for the generalized nonlinear wave equation in (3+1) dimensions with gas bubbles using the Nucci's reduction, enhanced and modified Kudryashov algorithms. Journal of Ocean Engineering and Science, 2022.

[3] Gu, M., Li, J., Liu, F., Li, Z., Peng, C.. Propagation of traveling wave solution of the strain wave equation in microcrystalline materials. Open Physics 2024, 22(1), 20240093.

[4] Malik, S., Hashemi, M.S., Kumar, S. et al. Application of new Kudryashov method to various nonlinear partial differential equations. Optical and Quantum Electronics, 2023, 55,(8).

[5] Baskonus, H. M., Raihen, M. N., & Kayalar, M. On the extraction of complex behavior of generalized higher-order nonlinear Boussinesq dynamical wave equation and (1+1)- dimensional Van der Waals gas system. AIMS Mathematics, 2024, 9(10), 28379–28399.

[6] Kudryashov, N.A.. (2019). First integrals and general solution of the Fokas-Lenells equation, Optik, 2019, 195 10.

[7] Taghizadeh, N., Mirzazadeh, M., Paghaleh, A., & Vahidi, J.. Exact solutions of non- linear evolution equations by using the modified simple equation method. Ain Shams Engineering Journal, 2012, 3(4), 321–325.

[8] Rehman,H.,Akber, R., Wazwaz,A., Alshehri, H., Osman, M.. Analysis of Brownian Motion in Stochastic Schrodinger Wave Equation using Sardar Sub-equation Method. Optik, 2023, 289. 171305. 10.

[8] Ya¸sar, E., & Koc¸asız, B.. Dual-mode nonlinear Schrodinger equation (DMNLSE): Lie group analysis, group invariant solutions, and conservation laws. International Journal of Modern Physics B, 2024, 2024, 1–26.

[9] Arnous,A.H., Seadawy,A.R.,Alqahtani,R.T., & Biswas, A.. Optical solitons with com- plex Ginzburg–Landau equation by modified simple equation method. Optik,2017, 144 475-480

[10] Kudryashov, N.A.. Method for finding optical solitons of generalized nonlinear Schrodinger equations, Optik, 2022, 261.
[11]Usman, M., Hussain, A., Zidan, A.M., & Mohamed, A.. Invariance properties of the microstrain wave equation arising in microstructured solids. Results in Physics, 2024.