

EXACT SOLUTIONS OF SOME NONLINEAR SYSTEMS  
OF PARTIAL DIFFERENTIAL EQUATIONS  
BY USING THE FUNCTIONAL VARIABLE METHOD

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**Abstract.** In this paper, we will employ the functional variable method for solving some nonlinear systems of partial differential equations which are very important in applied sciences, namely, the generalized Drinfel'd-Sokolov-Wilson system, Bogoyavlenskii equations and Davey-Sterwatson equations. This approach provides a more powerful mathematical tool for solving nonlinear differential equations which can be converted to a second-order ordinary differential equation through the travelling wave transformation.

**MSC 2010.** 83C15, 74J35, 93C10.

**Key words.** Functional variable method, Generalized Drinfel'd-Sokolov-Wilson system, Bogoyavlenskii equations, Davey-Sterwatson equations, Nonlinear system.

REFERENCES

- [1] AMINIKHAH, H., REFAHI SHEIKHANI, A. and REZAZADEH, H., *Functional variable method for solving the generalized reaction Duffing model and the perturbed Boussinesq equation*, Adv. Model. Optim., **17** (2015), 55–65.
- [2] BOGOYAVLENSKII, O.I., *Breaking solitons in  $(2 + 1)$ -dimensional integrable equations*, Russian Math. Surveys., **45** (1990), 1–86.
- [3] DAVEY, A. and STEWARTSON, K., *On three-dimensional packets of surface waves*, Proc. R. Soc. Lond. Ser. A., **338** (1974), 101–110.
- [4] EBADI, G., KRISHNAN, E.V., JOHNSON, S. and BISWAS, A., *Cnoidal wave, snoidal wave, and soliton solutions of the  $D(m, n)$  equation*, Arab. J. Math., **2** (2013), 19–31.
- [5] EVANS, D.J. and RASLAN, K.R., *The tanh function method for solving some important non-linear partial differential equations*, Int. J. Comput. Math., **82** (2005), 897–905.
- [6] KHAN, K., AKBAR, M.A. and NUR ALAM, M., *Traveling wave solutions of the nonlinear Drinfel'd-Sokolov-Wilson equation and modified Benjamin-Bona-Mahony equations*, J. Egyptian Math. Soc., **21** (2013), 233–240.
- [7] KUDRYASHOV, N.A. and PICKERING, A., *Rational solutions for Schwarzian integrable hierarchies*, J. Phys. A., **31** (1998), 9505–9518.
- [8] MALIK, A., CHAND, F., KUMAR, H. and MISHRA, S.C., *Exact solutions of the Bogoyavlenskii equation using the multiple  $(G'/G)$ -expansion method*, Comput. Math. Appl., **64** (2012), 2850–2859.
- [9] MCCONNELL, M., FOKAS, A.S. and PELLONI, B., *Localised coherent solutions of the DSI and DSII equations – a numerical study*, Math. Comput. Simulation., **69** (2005), 424–438.
- [10] NAZARZADEH, A., ESLAMI, M. and MIRZAZADEH, M., *Exact solutions of some nonlinear partial differential equations using functional variable method*, Pramana., **81** (2013), 225–236.

- [11] PARKES, E.J., DUFFY, B.R. and ABBOTT, P.C., *The Jacobi elliptic-function method for finding periodic-wave solutions to nonlinear evolution equations*, Phys. Lett. A., **295** (2002), 280–286.
- [12] TIAN, B. and GAO, Y.T., *Observable solitonic features of the generalized reaction Duffing model*, Int. J. Phys. Sci., **57** (2002), 39–44.
- [13] WANG, D. and ZHANG, H.Q., *Further improved F-expansion method and new exact solutions of Konopelchenko-Dubrovsky equation*, Chaos, Solitons & Fractals., **25** (2005), 601–610.
- [14] WAZWAZ, A.M., *Exact and explicit travelling wave solutions for the nonlinear Drinfeld-Sokolov system*, Commun. Nonlinear Sci. Numer. Simul., **11** (2006), 311–325.
- [15] WAZWAZ, A.M., *The variational iteration method for rational solutions for KdV, K(2,2), Burgers, and cubic Boussinesq equations*, J. Comput. Appl. Math., **207** (2007), 18–23.
- [16] ZAYED, E.M., HODA IBRAHIM, S.A., SIMOS, T.E. , PSIHOYIOS, G., TSITOURAS, C. and ANASTASSI, Z., *The functional variable method and its applications for finding the exact solutions of nonlinear PDEs in mathematical physics*, AIP Conference Proceedings-American Institute of Physics., **1479** (2012), 2049–2053.
- [17] ZERARKA, A. and OUAMANE, S., *Application of the functional variable method to a class of nonlinear wave equations*, World J. Model. Simul., **6** (2010), 150–160.
- [18] ZERARKA, A., OUAMANE, S. and ATTAF, A., *On the functional variable method for finding exact solutions to a class of wave equations*, Appl. Math. Comput., **217** (2010), 2897–2904.
- [19] ZHANG, S. and XIA, T.C., *A further improved extended Fan sub-equation method and its application to the (3 + 1)-dimensional Kadomstev-Petviashvili equation*, Phys. Lett. A., **356** (2006), 119–123.
- [20] ZHANG, S. and XIA, T.C., *A generalized auxiliary equation method and its application to (2 + 1)-dimensional asymmetric Nizhnik-Novikov-Vesselov equations*, J. Phys. A., **40** (2007), 227.
- [21] ZHANG, W.M., *Solitary solutions and singular periodic solutions of the Drinfeld-Sokolov-Wilson Equation by variational approach*, Appl. Math. Sci., **5** (2011), 1887–1894.

Received October 28, 2014

Accepted April 6, 2015

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