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Corrigendum to the paper "Study of Chirped Optical Solitons in Dimensional form of Nonlinear Schrödinger equation"

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Abstract

This paper purports to study the optical solitons solutions regarding the nonlinear schrödinger equation with dual power law of nonlinearity along with self steeping and repercussion. The optical solutions mostly comprise of singular solitons with nonlinear chirping. The adopted solitary wave ansatz and the importance of the obtained chirped soliton pulses are also discussed.

Key words and phrases: Nonlinear Optics, Nonlinear Schrödinger's equation, Solitons solutions.
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1 Introduction

In the field of nonlinear optics, solitons are well-known topics of research. There are various representations and evaluation processes of physical systems from fluids to optics. Examining the manufacturing phenomena of transfer across trans-oceanic and trans-continental solitary wave solutions obtained through analytical method are very useful and many well-organized methods have been developed during the past few decades [5,6]. A Solitary wave is a wave packet which propagates in non-dispersive media [7] and maintains its shape even after collision with other solitons.
For decades this area of research has made a vast development. Optical soliton is one of the main areas of research in the non-linear optics field. Here we are using a quite different approach and we present a broad variety of chirped optical soliton solutions non-linear Schrodinger equation (NLSE) with constant coefficients and third order dispersion and self-steepening effect [8]. We determine the existence of dark, singular and bright solitons. We also show that the resulting chirp has linear and nonlinear contributions associated with each of these optical solitons and directly proportional to the linearity of the wave. Recently, numerous efficient and powerful techniques have been used to obtain exact bright, dark, and singular soliton solutions of the NLSE model with Power, Double power, and Kerr nonlinear properties [30-45]. In this article, we will use another method to obtain a set of soliton solutions for GRD-NLSE with dual power law nonlinearity [1]. The soliton solutions include bright, dark, and singular nonlinear chirp solitons for the model discussed

$$iq_t + aq_{xx} + b|q|^{2m}q = i\alpha q_x - i\gamma q_{xxx} + i\lambda(|q|^{2m}q)_x + i\nu(|q|^{2m})_x q \tag{1.1}$$

The wave profile is denoted by the complex valued function $q(x,t)$, where x and t are the independent variables. In Eq.(1.1) a and b are real numbers and a shows the group velocity dispersion (GVD) component, and b is the nonlinearity coefficient. In Eq.(1.1) γ is the third-order dispersion and α represents the coefficient of the intermodal dispersion, λ is the constant correspondingly related with self-steepening (SS) and amplification. Finally, the non-linear dispersion coefficient is ν. Eq. (1.1) is the NLSE with dual power law nonlinearity. In Eq.(1.1) m is the dual power law parameter with m = 1,2,3, ... n, the nonlinearities of the order up to $2n+1$. If $m = 1$, then we get the Kerr nonlinearity. If $m = 2$, then we get the quintic [10]. If $m = 3$, then we get the septic and so on.

2 Substance of Solitons

To find the chirp optical solitons solution we consider the transformation

$$q(x,t) = \rho(s)e^{i[\chi(\xi)-\omega t]}, \tag{2.2}$$

where ρ is a real valued function and χ is traveling waves concatenates [5]. Hence the associated chirp in given by $\delta\Omega(t,x) = -\frac{\partial}{\partial x}[\chi(\xi)-\omega t] = -\acute{\chi}(\xi)$. Substituting Eq.(2.2) into Eq.(1.1) and separating imaginary and real parts, we get the following equations

$$-\omega\rho - u\rho' + 2a\rho'\chi' + a\rho\chi'' - \alpha\rho' - \gamma\rho'\chi'^2 - \gamma\rho\chi''\chi' - \gamma\rho\chi'^2 - 2\gamma\rho\chi'\chi'' - \gamma\rho'\chi'^2 \\ +\gamma\rho''' - 2\lambda m\rho^{2m}\rho' - \lambda\rho^{2m}\rho' - 2\nu m\rho^{2m}\rho' = 0 \tag{2.3}$$

and

$$a\rho'' + u\rho\chi' - a\rho\chi'^2 + b\rho^{2m+1} = -\alpha\rho\chi' - \gamma\rho\chi'^3 + \gamma\rho''\chi + \gamma\rho'\chi'' + \gamma\rho''\chi' \\ +\gamma\rho\chi''' + \gamma\chi''\rho + \gamma\chi''\rho' + \gamma\chi'\rho'' - \lambda\rho^{2m+1}\chi'. \tag{2.4}$$

Now we use an ansatz given by Eq.(2.5) to solve equation Eq.(2.3) and Eq.(2.4). This transformation depends on the amplitude of wave

$$\acute{\chi} = \beta\rho^{2m} + \eta. \tag{2.5}$$

So, the resultant chirp takes the form $\delta\sigma(t,x) = -(\beta\rho^{2m}+\eta)$. The nonlinear chirp parameters are β and η [5]. This gives the chirp which propagates rely on intensity, $\delta\sigma(t,x) = -(\beta\rho^{2m}+\eta)$, where $I = |q|^2 = \rho^2$.

Now, by putting the transformation Eq.(2.5) in Eq.(2.4), we get relations for β and η

$$\beta = -\frac{2m(\lambda+\nu-a)+\lambda}{2a-2\gamma\eta(2+3m)}. \tag{2.6}$$

and

$$\eta = \frac{a+\sqrt{a^2-2u\gamma-2\alpha\gamma}}{2\gamma}. \tag{2.7}$$

substituting Eq.(2.5)-(2.7) into Eq.(2.3) we get

$$\rho'' + \sigma_1\rho^{2m+1} + \sigma_2\rho^{4m+1} + \sigma_3\rho + \sigma_4\rho^{2m}\rho' + \sigma_5\rho^{6m+1} + \alpha_6\rho^{2m}\rho'' \\ +\alpha_7\rho^{2m-1}\rho'^2 = 0 \tag{2.8}$$

Eq.(2.8) is elliptic which shows the amplitude growth in nano optical fiber. Now we want to find an equation for Eq.(2.8) which is analytical for the values of $a_i \neq 0$, where $(i = 1, 2, ...7)$ to get singular dark, bright and soliton solutions. The $a_i's$ are given below

$$\sigma_1 = -\frac{\beta(u + 2a\eta + \alpha + 3\gamma\eta^2) + b + \lambda\eta}{a - \gamma\eta}, \quad \sigma_2 = \frac{\beta(a\beta + 3\beta\gamma + \lambda)}{a - \gamma\eta},$$
$$\sigma_3 = -\frac{\beta(u + 2a\eta + \alpha + 3\gamma\eta^2) + b + \lambda\eta}{a - \gamma\eta^2}, \quad \sigma_4 = \frac{-4m\gamma\beta}{a - \gamma\eta}, \quad \sigma_5 = \frac{\gamma\beta^3}{a - \gamma\eta},$$
$$\sigma_6 = -\frac{3\gamma\beta}{a - \gamma\eta}, \quad \sigma_7 = -\frac{4m\gamma\beta}{a - \gamma\eta} \quad (2.9)$$

We will also find families solution for chirped solitons for higher order GRD-NLSE.

3 Chirped Solitons

Here we give the exact solitons solution of Eq.(1.1). The exact solution arises from the presence of physical constraints as in previous studies. These solutions deliver results in the form of non-linear pluses which depend on the intensity of the impulse force.

3.1 Bright Solitons

Here we will present solution of the chirped soliton and its major types. There we came across two kinds of bright solutions with parametric settings. We obtain two types of bright solutions with parametric settings.
These solutions were obtained in explicit form. Hence the related chirping are given below

Case I: Suppose the bright solitons is of the form.

$$\rho(\xi) = \frac{B}{[1 + D\cosh(L\xi)]^{1/2m}}, \quad (3.10)$$

The values of B, D and L are given by

$$B = \left[\frac{2(1+m)\sigma_3}{\sigma_3\sigma_6 - \sigma_1 + \sigma_3\sigma_7}\right]^{1/2m}, \quad (3.11)$$

$$D = \left[-\frac{\sigma_1}{(1+2m)\sigma_3\sigma_6 + \sigma_3\sigma_7} \right]^{1/2} \tag{3.12}$$

and

$$L = \left[-4m^2\sigma_3 \right]^{1/2}. \tag{3.13}$$

The bright soliton is exact if $(1+2m)\sigma_3\sigma_6 + \sigma_3\sigma_7 < 0$ is an even integer by Eq.(3.12). But, if m is an odd integer of Eq.(3.12), then it is pointing downwards.

$$q(x,t) = \frac{B}{[1 + D\cosh(L\xi)]^{1/2n}} e^{i[\chi(\xi)-\omega t]}, \tag{3.14}$$

the following relation show frequent chrip

$$\delta\Omega(t,x) = -\left(\frac{\beta B^{2m}}{1 + D\cosh(L\xi)} + \eta \right). \tag{3.15}$$

where the values of B, D and L re specified in equations (3.11)-(3.13).

Case II: Suppose another bright soliton solution is of the form

$$\rho(\xi) = \frac{C}{[1 + \kappa\cosh^2(Q\xi)]^{1/2m}}, \tag{3.16}$$

where C, Q and κ values are given below

$$C = \left[-\frac{2(1+m)\sigma_3}{\sigma_1 - \sigma_3\sigma_6 - 4m^2\sigma_3\sigma_7} \right]^{1/2m}, \tag{3.17}$$

$$Q = \left[-m^2\sigma_3 \right]^{1/2} \tag{3.18}$$

and

$$\kappa = \left[-\frac{2(1+m)\sigma_3\sigma_4 + \sigma_1(\sigma_1 - \sigma_3\sigma_6 - 4m^2\sigma_3\sigma_7)}{m\sigma_3\sigma_6(\sigma_1 - \sigma_3\sigma_6 - 4m^2\sigma_3\sigma_7)} \right]. \tag{3.19}$$

It is essential to have $\sigma_1 - \sigma_3\sigma_6 - 4m^2\sigma_3\sigma_7 > 0$ bright soliton produce if we take the value of n to be even. By putting these values in Eq.(3.16) we get bright soliton with nonlinear chirp as

$$Q(x,t)=\frac{C}{[1+\kappa cosh^2(Q\xi)]^{1/2m}}e^{i[\chi(s)-\omega t]}, \tag{3.20}$$

and its resulting chirping takes the form

$$\delta\Omega(x,t)=\left(\frac{C^{2m}}{[1+\kappa cosh^2(Q\xi)]}+\eta\right) \tag{3.21}$$

where C, Q, κ are given by the relations (3.17)-(3.19).

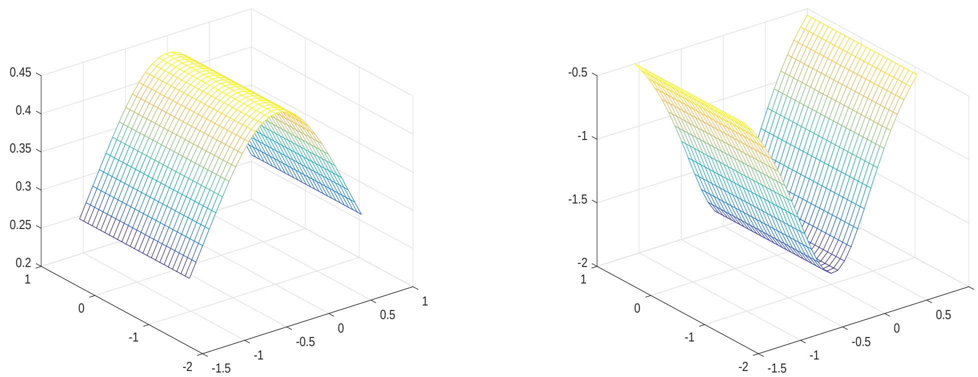

Figure 1: Bright Soliton of Case I and Case II

with the different parameters of case I, $\mu = 6.4, T = 1.37, q = -1.6, -\frac{\pi}{3} < \xi < \frac{\pi}{3}, M = 2, n = 1, p = 0.5$ and case II, $Q = 0.4, p = 1.18, q = -1.3, m_1 = 0.5, m_2 = 4, -\frac{\pi}{3} < \xi < \frac{\pi}{3}$

3.2 Dark Solitons

Now we discuss dark soliton solutions which are also interesting because of their stability due to the effects of material losses. To justify the constraints, two kinds of dark soliton solutions are given by equation Eq.(1.1).
Consider the following form of dark soliton solutions

$$\rho(\xi) = [E(1 \pm \tanh(\Phi\xi))]^{1/2m}, \tag{3.22}$$

where the values of E and Φ are given by,

$$\Phi = \left[2m^2\sigma_3\right]^{\frac{1}{2}}, \tag{3.23}$$

and

$$E = -\left[\frac{\sigma_3\sigma_7 - (1+2m)\sigma_3\sigma_7}{2\sigma_5}\right]^{\frac{1}{2}}. \tag{3.24}$$

provided that the wave parameter Φ is real, the chirped dark soliton solution of Eq.(1.1) takes the form.

$$Q(x,t) = E(1 \pm \tanh(\Phi\xi))]^{1/2m} e^{i[\chi(s) - \omega t]}, \tag{3.25}$$

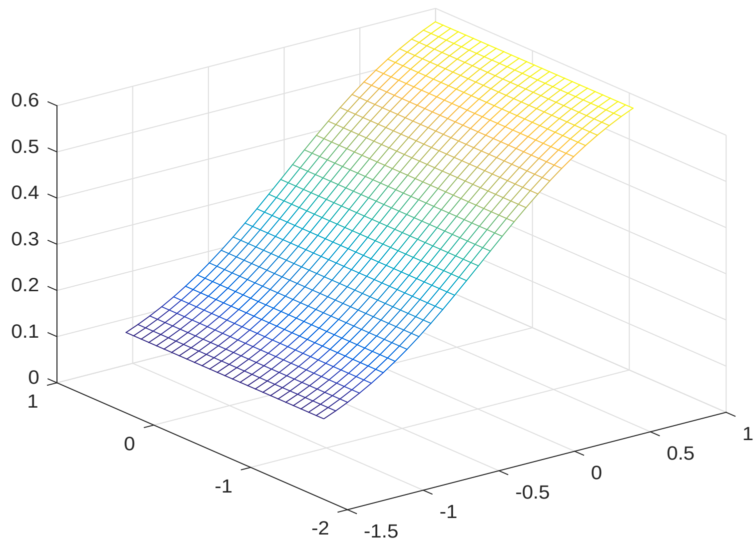

Figure 2: Dark Soliton
with the, $Q = 1.4, E = 8, p = 0.2, q = 1.5, n = 1, -\frac{\pi}{3} < \xi < \frac{\pi}{3}$.

while the associated chirping is

$$\delta\Omega(t, x) = -\beta E(1 \pm \tanh(\Phi\xi) + \eta), \tag{3.26}$$

where Φ and E are given by the relations Eq.(3.23) and Eq.(3.24).

3.3 Singular Solitons

There are two kinds of singular solutions which result under definite constraints conditions. These groups of actual singular solutions are reflected in terms of the functions "coth" and "sinh".

Now we discus the two kinds of singular soliton solutions under certain constraints. These two groups of actual singular solutions, given by the two functions "coth" and "sinh".
Case I: : Consider the first type of singular soliton solution of the form

$$\rho(\xi) = [G(1 \pm \coth(\vartheta\xi))]^{1/2m}, \tag{3.27}$$

where the values of ϑ and G are

$$\vartheta = \left[2m^2\sigma_3\right]^{1/2}, \tag{3.28}$$

and

$$G = -\left[\frac{\sigma_3\sigma_3 + (1+2m)\sigma_3\sigma_6}{\alpha_2}\right]^{1/2}. \tag{3.29}$$

provided ϑ is real. Thus we have a chirped singular soliton solution for Eq.(1.1)

$$Q(x,t) = [G(1 \pm \coth(\vartheta\xi))]^{1/2m} e^{i[\chi(s)-\omega t]}, \tag{3.30}$$

to consequent chirping set by

$$\delta\Omega(t,x) = -\beta G(1 \pm \coth(\vartheta\xi)) - \eta. \tag{3.31}$$

On the other hand, ϑ and G are illustrated by Eq. (3.28) and Eq.(3.29).

Case II: Now consider another singular soliton solution

$$\rho(\xi) = \frac{N}{[1 + R\sinh(\tau\xi)]^{1/2m}}, \tag{3.32}$$

where the values N, R and τ are

$$N = \left[-\frac{2(1+m)\sigma_3}{\sigma_1 - \sigma_3\sigma_6 - \sigma_3\sigma_7}\right]^{1/2m}, \tag{3.33}$$

$$R = \left[-\frac{\sigma_1}{(1+2m)\sigma_3\sigma_6 + \sigma_3\sigma_7}\right]^{1/2} \tag{3.34}$$

and

$$\tau = -\left[4m^2\sigma_2\right]^{1/2}. \tag{3.35}$$

Based on the results above, Singular soliton solution of Eq.(1.1) is given by

$$Q(x,t) = \frac{N}{[1 + R\sinh(\tau\xi)]^{1/2m}} e^{i[\chi(s)-\omega t]}, \tag{3.36}$$

where the consequent is of the form

$$\delta\Omega(t,x) = -\left(\frac{\beta N^{2m}}{1 + R\,\sinh(\tau\xi)} + \eta\right), \tag{3.37}$$

where N, R, τ and are given by the relations (3.33)-(3.35) with the different parameters of case I $\mu = 2.3, G = 7.4, p = -2, q = -1.2, n = 3, -\frac{\pi}{3} < \xi < \frac{\pi}{3}$ and case II $\mu = 4.5, p = 1.5, N = 12, R = 1.5, -\frac{\pi}{3} < \xi < \frac{\pi}{3}, n = 3, q = 1.5$.

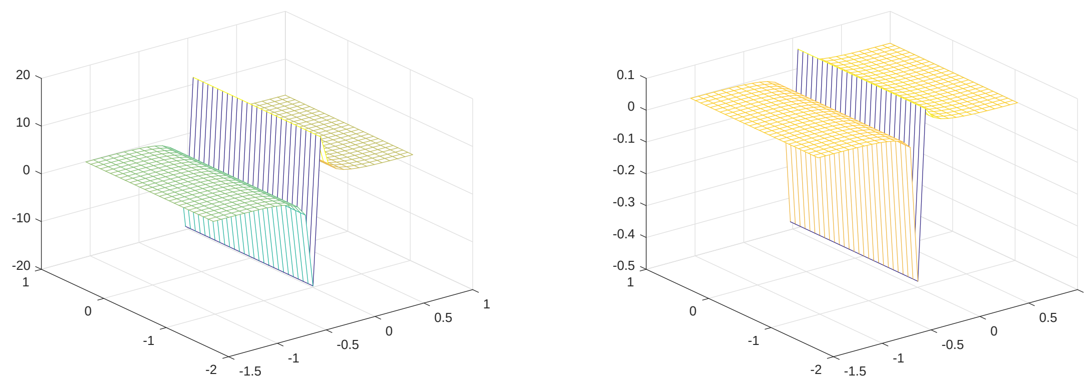

Figure 3: Singular Soliton with Case I and Case II

4 Conclusion

We will delve deep into the nonlinear Schrödinger equation with the dual power law under the lenses of generalized resonant dispersive nonlinear terminologies. Here, we have taken another aspect related to nonlinear chirping with the soliton pulses which travel in that medium. An assorted class of soliton solution have been taken into consideration which shows non trivial phase that ages with extreme intensity. The nonlinear chirp is closely linked with each soliton solution.

The feasible conditions for the application of chirped pulses are also elicited. The results are of primary importance especially regarding the nano fiber optic system. Hence, in this way chirped solitons are gained. The analogues which are contributing to the criterion are also taken into consideration that are observed during analysis. This work paves the way for future research and offers students a lot of encouragement and inspiration in the field of chirped soliton. Conditions for the propagation of chirped pulses to exist are also extracted. The results thus obtained are of prime importance, in particular, for soliton-particularly applications of nano optical fiber systems.

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References

[1] M. Mirzazadeha, M. Ekici, Q. Zhouc, A. Biswasd, Exact solitons to generalized resonant dispersive nonlinear Schrödinger's equation with power law nonlinearity, *Journal of Optik*, **130,** (2017), 178–183.

[2] A. Bouzida, H. Triki, A. Biswa, Q. Zhou, Chirped optical solitons in nano optical fibers with dual-power law nonlinearity, *Journal of Optics*, **142,** (2017), 77–81. (2017).

[3] B. Younas, M. Younis, M. O. Ahmed, S. T. R.Rizvi, Chirped optical solitons in nanofibers, *Modern Physics Letters B*, **32,** (2018).

[4] D. Yamigno Serge, K. Timoleon Crepin, Optical chirped soliton in metamaterials, *Nonlinear Dynamics*, **158,** Issue 1, (2018), 312–315.. (2018).

[5] A. Biswas, A. Bouzida, Chirped Optical Solitons In Nano Optical Fibers With Dual-Power Law Nonlinearity, *International Journal for Light and Electron Optics,* **142,** Issue 1, (2017), 77–81.

[6] M.Younis, S. T. R. Rizvi, Dispersive Optical Solitons in Nanofibers with Schrdinger-Hirota Equation, *Journal of Nonlinear Optical Physics & Materials,* **11,** (2016), 382–387.

[7] B. Younas, M. Younis, M. O. Ahmed, S. T. R. Rizvi, Exact optical solitons in (n+ 1)-dimensions under anti-cubic law of nonlinearity, *Journal of Optik*, **156,** (2018), 479–486.

[8] N. Cheemaa, S. A. Mehmood, S. T. R. Rizvi, M. Younis, Single and combined optical solitons with third order dispersion in Kerr media, *Optik*, **127,** (2016), 8203–8208.

[9] M. Younis, N. Cheemaa, S. T. R. Rizvi, & S.A. Mehmood, On optical solitons: The chiral nonlinear Schrodinger equation with perturbation and Bohm potential, *Optical and Quantum Electronics*, **48,** (2016), 542–556.

[10] M. Younis, S. T. R. Rizvi, Dispersive dark optical soliton in (2+1)-dimensions by G'/G-expansion with dual-power law nonlinearity, Optik, **126,** (2015), 5812–5814.

[11] S. T. R. Rizvi, I. Ali, K. Ali, M. Younis, Saturation of the nonlinear refractive index for optical solitons in two-core fibers, Optik, **127,** (2016), 5328–5333. (2016).

[12] A. H. Arnous, M. Mirzazadeh, S. Moshokoa, S. Medhekar, Q. Zhou, M. F. Mahmood, A. Biswas, M. Belic, Solitons in Optical Metamaterials with Trial Solution Approach and Bäcklund Transform of Riccati Equation, Journal of Computational and Theoretical Nanoscience, **12,** (2015), 5940–5948.

[13] W. J. Liu, B. Tian, Symbolic computation on soliton solutions for variable-coefficient nonlinear Schrodinger equation in nonlinear optics, Optical and Quantum Electronics, **43,** (2012), 147–162.

[14] W. Islam, M. Younis, S. T. R. Rizvi, Optical solitons with time fractional nonlinear Schrodinger equation and competing weakly nonlocal nonlinearity, Optik, **130,** (2017), 562–567.

[15] S. F. Tian, Initial boundary value problems for the general coupled nonlinear Schrödinger equation on the interval via the Fokas method, Journal of Differential Equations, **262,** (2017), 506–558.

[16] S. F. Tian, The mixed coupled nonlinear Schrodinger equation on the half-line via the Fokas method, Proc. R. Soc. A, **472,** (2016), 2016.0588.

[17] M. Mirzazadeh, M. Eslami, E. Zerrad, M. F. Mahommd, A. Biswas, M. Belic, Optical solitons in nonlinear directional couplers by sine-cosine function method and Bernoulli's equation approach, Nonlinear Dynamics, **81,** (2015), 1933–1949.

[18] M. Mirzazadeh, A. H. Arnous, M. F. Mahmood, E. Zerrad, A. Biswas, Soliton solutions to resonant nonlinear Schrödinger's equation with time-dependent coefficients by trial solution approach, Nonlinear Dynamics, **81,** (2015), 277–282.

[19] W. X. Ma, Y. You, Solving the Korteweg-de Vries equation by its bilinear form: Wronskian solutions, Transactions of the American Mathematical Society, **357,** (2005), 1753–1778.

[20] W. X. Ma, C. X. Li, J. He, A second Wronskian formulation of the Boussinesq equation, Nonlinear Analysis: Theory, Methods Applications, **70,** (2009), 4245–4258.

[21] W. X. Ma, M. Chen, Direct search for exact solutions to the nonlinear Schrödinger equation, Applied Mathematics and Computation, **215,** (2009), 2835–2842.

[22] X. B. Wang, S. F. Tian, C. Y. Qin, T. T. Zhang, Dynamics of the breathers, rogue waves and solitary waves in the (2+1)-dimensional Ito equation, Applied Mathematics Letters, **68,** (2017), 40–47.

[23] X. B. Wang, S. F. Tian, C. Y. Qin, T. T. Zhang, On integrability and quasi-periodic wave solutions to a (3+1)-dimensional generalized KdV-like model equation, Applied Mathematics and Computation, **283,** 216–233.

[24] M. J. Xu, S. F. Tian, J. M. Tu, T. T. Zhang, Bäcklund transformation, infinite conservation laws and periodic wave solutions to a generalized (2+1)-dimensional Boussinesq equation, Nonlinear Anal.: Real World Applications, **31,** (2016), 388–408.

[25] L. L. Feng, S. F. Tian, X. B. Wang, T. T. Zhang, Rogue waves, homoclinic breather waves and soliton waves for the (2+1)-dimensional B-type Kadomtsev-Petviashvili equation, Applied Mathematics Letters, **65,** (2017), 90–97.

[26] J. M. Tu, S. F. Tian, M. J. Xu, P. L. Ma, T. T. Zhang, On periodic wave solutions with asymptotic behaviors to a image-dimensional generalized B-type Kadomtsev-Petviashvili equation in fluid dynamics, Computers & Mathematics with Applications, **72,** (2016), 2486–2504.

[27] M. Inc, E. Ates, Optical soliton solutions for generalized NLSE by using Jacobi elliptic functions, Optoelectronics and Advanced Metarials-Rapid Communications, **9,** (2015), 1081–1087.

[28] B. Kilic, M. Inc, On optical solitons of the resonant Schrödinger's equation in optical fibers with dual-power law nonlinearity and time-dependent coefficients, Waves in Random and Complex Media, **25,** (2015), 245–251.

[29] M. Inc, B. Kilic, D. Baleanu, Optical soliton solutions of the pulse propagation generalized equation in parabolic-law media with space-modulated coefficients, Optik, **127,** (2016), 1056–1058.

[30] B. Kilic, M. Inc, D. Baleanu, On combined optical solitons of the one-dimensional Schrödinger's equation with time dependent coefficients, Open Physics, **14,** (2016), 65–68.

[31] B. Kilic, M. Inc, Soliton solutions for the Kundu-Eckhaus equation with the aid of unified algebraic and auxiliary equation expansion methods, Journal of Electromagnetic Waves and Applications, **30,** (2016), 871–879.

[32] M. Inc, E. Ates, F. Tchier, Optical solitons of the coupled nonlinear Schrodinger's equation with spatiotemporal dispersion, Nonlinear Dynamics, **85,** (2016), 1319–1329.

[33] F. Tchier, E. C. Aslan, M. Inc, Optical solitons in parabolic law medium: Jacobi elliptic function solution, Nonlinear Dynamics, **85,** (2016), 257-7-2582.

[34] F. Tchier, E. C. Aslan, M. Inc, Nanoscale Waveguides in Optical Metamaterials: Jacobi Elliptic Function Solutions, Journal of Nanoelectronics and Optoelectronics, **12,** (2017), 526–531.

[35] E. C. Aslan, M. Inc, D. Baleanu, Optical solitons and stability analysis of the NLSE with anti-cubic nonlinearity Superlattices and Microstructures, **109,** (2017), 784–793.

[36] M. Inc, A. I. Aliyu, A. Yusuf, Solitons and conservation laws to the resonance nonlinear Shrödinger's equation with both spatio-temporal and inter-modal dispersions, International Journal for Light and Electron Optics, **142,** (2017), 509–522.

[37] M. M. A. Qurashi, E. Ates, M. Inc, Optical solitons in multiple-core couplers with the nearest neighbors linear coupling, International Journal for Light and Electron Optics, **142,** (2017), 343–353.

[38] B. Kilic, M. Inc, Optical solitons for the Schrödinger-Hirota equation with power law nonlinearity by the Bäcklund transformation, International Journal for Light and Electron Optics, **138,** (2017), 64–67.

[39] M. M. Al Qurashi, D. Baleanu, M. Inc, Optical solitons of transmission equation of ultra-short optical pulse in parabolic law media with the aid of Bäcklund transformation, International Journal for Light and Electron Optics, **140,** (2017), 114–122.

[40] E. C. Aslan, F. Tchier, M. Inc, On optical solitons of the Schrödinger-Hirota equation with power law nonlinearity in optical fibers, Superlattices and Microstructures, **105,** (2017), 48–55.

[41] M. M. Al Qurashi, A. Yusuf, A. I. Aliy, M. Inc, Optical and other solitons for the fourth-order dispersive nonlinear Schrödinger equation with dual-power law nonlinearity, Superlattices and Microstructures, **105,** (2017), 183–197.

[42] M. Inc, A. I. Aliyu, A. Yusuf, D. Baleanu, Optical solitons and modulation instability analysis of an integrable model of (2+1)-Dimensional Heisenberg ferromagnetic spin chain equation, Superlattices and Microstructures, **112** (2017), 628–638.

[43] M. Inc, E. Ates, F. Tchier, Optical solitons of the coupled nonlinear Schrödinger's equation with spatiotemporal dispersion, Nonlinear Dynamics, **85,** (2016), 1319–1329.

[44] F. Tchier, E. C. Aslan, M. Inc, Optical solitons in parabolic law medium: Jacobi elliptic function solution, Nonlinear Dynamics,**85,** (2016), 2577–2582.

[45] E. C. Aslan, M. Inc, Soliton solutions of NLSE with quadratic-cubic nonlinearity and stability analysis, Waves in Random and Complex Media, **27,** (2017), 594–601.

[46] X. Lu, F. Lin, Soliton excitations and shape-changing collisions in alpha helical proteins with interspine coupling at higher order, Communications in Nonlinear Science and Numerical Simulation, **32,** (2016), 241–261.

[47] X. Lu, S. T. Chen, W. X. Ma, Constructing lump solutions to a generalized Kadomtsev-Petviashvili-Boussinesq equation, Nonlinear Dynamics, **86,** (2016), 523–534.

[48] X. Lu, J. P. Wang, F. H. Lin, X. W. Zhou, Lump dynamics of a generalized two-dimensional Boussinesq equation in shallow water, Nonlinear Dynamics, **91,** (2018), 1249–1259.