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General analytic solutions to the various forms of the nonlinear Schrödinger equation using the Jacobi elliptic function expansion method

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The advent of meta-materials has made materials with a negative refractive index possible. This has opened up a possibility of finding stable solutions to various nonlinear equations that naturally occur in the field of nonlinear optics through the use of dispersion management. Finding such stable solutions is invaluable for the field of photonics and has many potential practical applications. In our work we use the F-expansion method applied to the Jacobi elliptic function, along with the principle of harmonic balance to find novel solutions to various forms of the Nonlinear Schrödinger equation (NLSE). This approach allowed us to assume a quadratic form for the phase with respect to the longitudinal variable and thus find solutions both with and without chirp. Earlier work done on the NLSE with Kerr nonlinearity, with both normal and anomalous dispersion, was generalized to nonlinearities of arbitrary polynomial nonlinearity. Stable solutions were also obtained for the Gross-Pitaevskii equation. These solutions were determined to be modulationally stable, either unconditionally or with dispersion management, depending on the signs of various parameters in the original equation. The method was subsequently generalized for functions satisfying an arbitrary elliptic differential equation, including Weierstrass elliptic functions. A relatively new line of research has been finding solutions to the NLSE in a parity-time (PT) conserving potential, i.e. one for which the real part is an even function and the complex part is an odd function. We found a rich new class of exact solutions where the potential resembles the Scarf II potential.

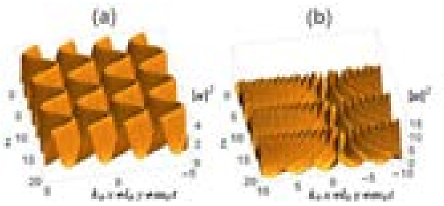

Figure1: Solution to the NLSE with Kerr nonlinearity using the Weierstrass elliptic function described in: (a) without chirp (b) with chirp

Biography

Nikola Z Petrović received his BSc in Mathematics and in Physics at MIT (Massachusetts Institute of Technology) in 2003 and his PhD in Physics at University of Belgrade in 2013. He was employed as a Teaching Associate and Lab Coordinator at Texas A&M University at Qatar from 2005 to 2012. He is currently an Assistant Research Professor at Institute of Physics, Belgrade. His primary field of expertise is Mathematical Physics applied to nonlinear optics, in particular finding novel exact solutions to the nonlinear Schrodinger equation, the Gross-Pitaevskii equation and other related equations.

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