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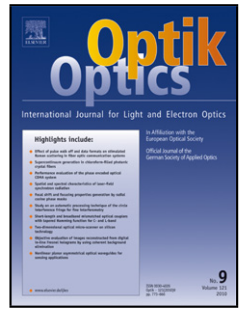

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Evolution of analytic solutions to the (3+1)-dimensional generalized nonlinear Schrödinger equation with variable coefficients and optical lattice

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Abstract: When laser pulses propagate in an inhomogeneous nonlinear medium, we theoretically investigate the evolution of laser pulses by analytically solving the (3+1)-dimensional generalized nonlinear Schrödinger equation with variable coefficients and optical lattice. A series of chirped-free and chirped analytic solutions, such as soliton solutions are found and intensities evolution of these analytic solutions are studied in detail. In the absence of optical lattice, we find that the intensities evolution of chirped-free and chirped analytic solutions vary regularly when the diffraction coefficient is the same as the dispersion coefficient. When the diffraction coefficient is different from the dispersion coefficient, the intensities evolution of chirped-free analytic solutions are regular variation, but the intensities evolution of chirped analytic solutions are irregular. In the presence of optical lattice, the intensities evolution of chirped analytic solutions vary regularly because the diffraction coefficient and the dispersion coefficient are always identical.

Keywords: analytic solution; evolution; variable coefficients; optical lattice

1. Introduction

When laser pulses propagate in an inhomogeneous nonlinear medium, theoretical analysis of the evolution characteristics of laser pulses is very important based on the analytic solution. The propagation of laser pulses in the inhomogeneous nonlinear medium is adequately described by the generalized nonlinear Schrödinger equation (GNLSE) with variable coefficients, which is an important universal model in many fields, such as nonlinear optics, Bose-Einstein and plasma physics [1-3]. In fact, most of the real nonlinear physical equations possess variable coefficients. For example, modern communication systems use fibers with variable dispersion. In the past decades, researchers theoretically have investigated the (1+1)-D [4-6], (2+1)-D [7-9] and (3+1)-D [10-13] GNLSE in-depth and many types of analytic solutions are found. When the inhomogeneous nonlinear medium has a periodic or nonperiodic lattice