Abstract

This thesis describes the generation, the propagation and structures of optical rogue waves in Kerr and chiral media. The dynamical behavior of rogue wave phenomenon is studied through scalar and vectorial nonlinear Schrodinger (NLS) models. Then, the similarity and Darboux transformations are used to construct the first-and second-order rational solutions related to optical rogue waves. The linear and nonlinear properties of rogue wave prototypes are investigated through analytical and numerical methods. Then, the influence and controllability of linear and nonlinear effects on rogue wave propagation are underlined. The study starts with an inhomogeneous nonparaxial NLS equation with varying dispersion, nonlinearity and nonparaxiality coefficients which governs the nonlinear wave propagation in an inhomogeneous optical fiber system. Optical rogue wave properties are analyzed through polynomial and Jacobian elliptic functions. Then follow the derivation of scalar and vectorial NLS equations with right-and left-hand nonlinear polarization. The features of chiral optical rogue waves are analyzed from analytical results, showing the influence of optical activity on rogue waves. Then, both scalar and vector nonparaxial NLS equations with constant and modulated coefficients are derived to improve the description of rogue wave propagation in optical chiral media. The condition of modulation instability of the background reveals the existence of vector rogue waves and the number of stable and unstable branches. Moreover, the influence of nonparaxiality, optical activity and walk-off effect are also evidence under the defocusing and focusing regimes of the vector nonparaxial NLS equations with constant and modulated coefficients. Through an algorithm scheme of wider applicability on nonparaxial beam propagation methods, the most influential effect and the simultaneous controllability of combined effects are underlined.

Keywords: *Optical rogue waves, Kerr and chiral media, nonparaxiality, similarity transformation, modified Darboux transformation, optical activity.*