Novel Asymptotic Soliton Waves for the Nonlinear Schrödinger Equation with Varying Gain/Loss and Frequency Chirping

Xian-Jing Lai[a] and Jie-Fang Zhang[b]

[a] Department of Basic Science, Zhejiang Shuren University, Hangzhou, 310015, Zhejiang, China
[b] Institute of Theoretical Physics, Zhejiang Normal University, Jinhua, 321004, Zhejiang, China

Reprint requests to X.-J. L.; E-mail: laixianjing@163.com

This paper analysis spatial asymptotic waves propagation in nonuniform optical fiber. It finds an appropriate transformation such that the nonlinear variable-coefficient Schrödinger equation transform into the nonlinear Schrödinger equation with varying gain/loss and frequency chirping. It obtains solitonlike and periodic self-similar asymptotic waves by using the transformation. We analyze the evolution properties of some novel self-similar solutions. In addition, the nature of our self-similar asymptotic wave hints to the possibility of designing optical amplifier and focusing of spatial waves to overcome inevitable energy losses while performing in the optical nonlinear media.