Effect of Frequency Chirp on the Black and Gray Solitons Propagation in Optical Fiber

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Abstract

The behavior of the first-order black and gray solitons propagated in optical fiber in the presence of frequency chirp is studied analytically and numerically. Results show that phase profile of black solitons changes abruptly by ($\Phi=\pi$) whereas for gray solitons phase profiles change more gradual and smaller than π. Black solitons characterized by the intensity at the dip falls to zero while for gray solitons the dip does not extend all the way to zero. Results indicate that the solitons pulses shift further from the axes of the link path designed as the value of darkness parameter (B) decreases. As a consequence of the frequency chirp the channel capacity performance of an optical communication link is reduced. Numerical study shows a good agreement with the analytical results.

1. Introduction

Solitons communications systems are leading candidates for long –light wave transmission links because they offer the possibility of a dynamic balance between group velocity dispersion (GVD) and nonlinear effect, the two effects that severely limit the performance of nonsoliton systems [1,2].

Dispersion effects have the effect of broadening short pulses as they propagate through the medium.The nonlinear effects in fiber media originates from the fact that the refractive index of the fiber medium depends on the intensity of the light pulse propagating through the fiber .The nonlinear effects have the effect of compression short pulses as they propagate through the fiber [3].

Mathematically speaking solitons are a localized solution of a nonlinear partial differential equations. However, in purely optical terms, optical solitons are solitary wave occurring in an envelope of a light wave and is referred to as envelope solitons. The first "solitary wave" was observed by *John Scott Russell* while observing motion in a canal ,saw a certain kind of wave retained its shape as it advanced, proceeding unchanged for more than a kilometer. Hasegawa and Tappert was first suggested n 973 he possibility of soliton propagation in optical fibers through the interaction between the nonlinear and dispersion effects [4]. However, lack of suitable source of picosecond optical pulses at wavelength >1.3μm delayed their experimental observation until 1980. Mollenauer et al. were able to observe bright solitons propagation in Bell Labs at the first time [5]. As mathematical results continued to appear, researches was experimenting intensively with optical bright solitons.

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