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original article

Effects of the amplifier location in interchannel soliton collisions in periodic dispersion maps in the presence of third order dispersion

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Abstract

We analyze the effects of third order dispersion in wavelength division multiplexed dispersion-managed soliton transmission systems using an ordinary differential equations model obtained by the variational method. Interchannel soliton collisions in this type of transmission systems produce shifts of their center frequencies which result in a timing jitter at the receiver that can severely impair signal transmission. We investigate how the third order dispersion term affects the collision-induced residual frequency shifts as the amplifier location within a period of the dispersion map is varied. The validity of the model employed in the analysis is assessed by comparing the variational results with direct simulations of the partial differential equations for specific cases, finding excellent agreement.

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Keywords: Optical solitons; Dispersion management; Wavelength division multiplexing; Third order dispersion; Optical fiber communication

1. Introduction

Dispersion management (DM) techniques permit to reduce several system penalties in fiber soliton transmission and have enabled long-distance optical soliton communication systems to become a reality [16]. We can describe the physical layout of a DM transmission system as a consecutive concatenation of alternate segments of normal and anomalous group velocity dispersion (GVD), in a periodic fashion, while typically maintaining an anomalous average dispersion along the transmission line with an absolute value much lower than the magnitude of the dispersion in each segment.

In the absence of fiber nonlinearity, the breathing pulse propagating in the link broadens with an average rate determined by the nonzero residual mean dispersion. This slow broadening can be canceled out if the fiber nonlinearity compensates the average residual dispersion. If the initial pulse energy is chosen carefully in order to exactly balance

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