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NUMERICAL SOLUTION OF LINEARLY DAMPED SPATIALLY FORCED NONLINEAR SCHRODINGER EQUATION

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Abstract. In this study, the generation and propagation of optical solitons in nonlinear dispersive optical fiber is modelled by one dimensional forced nonlinear Schrdinger (fNLS) equation. In the absence of periodic amplification, the driving function in the driven nonlinear Schrdinger equation is replaced by a time variant space-dependent forcing function. A Gaussian forcing term is introduced to the nonlinear Schrdinger (NLS) equation to modify it into the fNLS equation. The fNLS equation is not integrable. It cannot be solved analytically due to the lack of group symmetries and that the number of conversation laws become finite. To approximate the fNLS equation for its soliton solutions, Crank-Nicolson implicit scheme was employed. The effects of fiber loss on optical solitons both in the presence and absence of Gaussian forcing are investigated. The similarities and differences between fiber loss and spatial forcing in terms of group velocity dispersion and self-phase modulation are discussed.

Keywords. forced nonlinear Schrdinger equation, optical soliton, fiber loss, Crank-Nicolson implicit scheme, Gaussian forcing

1 Introduction

The fiber-optic telecommunication system brings a wider bandwidth (up to 10 Gps) along with a faster data transmission and an extremely lower loss. It is yet lighter in weight, immune to electromagnetic interference and more durable than electrical cable transmission systems [1].

Such systems utilize electromagnetic waves to transfer data through optical fiber. Optical fiber is a nonlinear dispersive medium in which light pulses experience group velocity dispersion (GVD) due to chromatic dispersion (for bright solitons) and self-phase modulation (SPM) due to the Kerr effect. GVD and SPM set restrictions to the performance of fiber-optic telecommunication.

An all-soliton fiber-optic telecommunication system is to ultimately avoid the restrictions from GVD and SPM, yet is to put them in good use to create