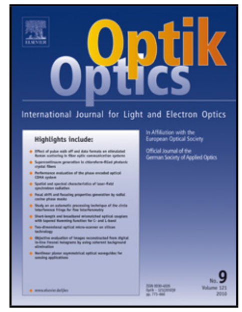
Accepted Manuscript



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PII: S0030-4026(16)30876-2
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2016.08.013
Reference: IJLEO 58030

To appear in:

Received date: 7-6-2016
Accepted date: 8-8-2016

Please cite this article as: K. Fakhar, Gangwei Wang, A.H. Kara, Symmetry reductions and conservation laws of the Short Pulse Equation, *<![CDATA[Optik - International Journal for Light and Electron Optics]]>* (2016), http://dx.doi.org/10.1016/j.ijleo.2016.08.013

Symmetry reductions and conservation laws of the Short Pulse Equation

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In this letter, we study invariance properties of the nonlinear short pulse equation through Lie symmetry analysis. We shown that this leads to several reductions yielding solutions of the short pulse equation. Furthermore, we obtain two conservation laws of the equation through the direct method. We show that two resulting nonlocally related systems yield no nonlocal symmetries of the short pulse equation. Some remarks and appropriate conclusions are drawn at the end.

PACS Nos. 02.30.Jr; 02.20Qs; 03.40Kf

Keywords: Short pulse equation; Lie symmetries; conservation laws; exact solutions

Although the nonlinear Schrödinger equation (NLSE) [1] forms the basis for optimizing existing fiber links, it is inadequate for describing ultra-short pulses. This leads to the derivation of the short pulse equation, as a model equation, to approximate the evolution of very short optical pulses in nonlinear media [2,3]. The short pulse equation (SPE) serves as a basic governing equation for many physical/mathematical models describing different processes in many scientific areas [4-7]. Several authors have analyzed the SPE in different contexts by utilizing various methods and obtained diverse classes of solutions [8-19]. References [11] and [15] have obtained travelling wave solutions. In [15], authors have used Lie symmetries: i.e.,translation symmetries and did detailed analysis, however, they only listed series type solutions through scaling symmetries and no analysis regarding combination of different symmetries etc. Although extensive literature is available on the SPE, the quest to explore the nonlinearity of the equation is still far from being complete. In the last few decades, active research efforts have been made on the derivation of conservation laws for PDEs. Consequently, several methods such as Noether's theorem [20] for variational problems, multiplier approach (direct method) [21-24], symmetry action on a known conservation law [25],

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