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A STUDY ON THREE TYPES OF NONLINEAR KLEIN-GORDON EQUATIONS

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Abstract. A mathematical approach based on the reduction of order for solving ordinary differential equations has been employed to investigate three forms of nonlinear Klein-Gordon equations. The analytical expressions of the travelling wave solutions such as compactons, solitons and periodic solutions for the equations are obtained. The results of this work extend parts of those provided by Wazwaz [Chaos, Solitons and Fractals 28(2006) 1005-1013].

Keywords. Klein-Gordon equations, compactons, solitons, periodic solutions, solving integral equations.

AMS (MOS) subject classification: 35K55, 35B40.

1 Introduction

Many analytical and numerical techniques have been employed to find travelling wave solutions of nonlinear partial differential equations. Rosenau and Hyman [1] used the pseudo spectral methods in space and a variable order, variable time-step Adams-Basford-Moulton method in time to study a family of nonlinear KdV equations, and obtained a class of solitary waves with compact support, which were called compactons. Wadati [2-4] developed the trace method to investigate the exact travelling wave solutions for a modified Kortweg-de Vries equation. The tanh method developed by Malfliet et al. [5-6] is a reliable algebraic technique to obtain exact solutions of many nonlinear equations. Wazwaz [8] used the tanh method to acquire the exact solutions for several forms of nonlinear dispersive partial differential equations. Making use of the extended tanh method and homogeneous balance method, Fan and Zhang [10] investigated the generalized $mKdV$ equation and the generalized ZK equation. This method was an efficient tool to seek exact solutions of nonlinear equations so that abundant solitary wave solutions were obtained (see [14]). Other approaches include the inverse scattering method, the Bäcklund transformation, the Darboux transformation, the painlevé analysis, the tri-Hamiltonian operators, the finite difference method, the Adomian decomposition method, the $\sin - \cos$ antaze method and so on.

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