

**Document Type** : Thesis

**Document Title** : A numerical study of sine grodon equation

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**Abstract** : This thesis is mainly concerned with solving the Sine-Gordon equation numerically using a family of finite difference methods which we have derived and where we have discussed and extracted different methods. In Chapter 1, we present the finite difference method for solving the hyperbolic equation in one dimension space, this equation describes the propagation of a wave. We present methods such as explicit method, implicit method, the numerical methods are developed by replacing the time and space derivatives by finite-difference approximations. The resulting finite-difference methods are analysed for local truncation errors, consistency, stability and convergence. In Chapter 2, we study and derive some exact solutions of the Sine Gordon equation, where we derive the single soliton and two soliton solutions and solitonanti-soliton solutions and we give some properties of these solutions. In Chapter 3, a full description of different numerical methods are given and a complete study of each method has been done, concerning, accuracy, stability and the solution of the resulting system. In Chapter 4, we present numerical results of the previous methods. A com- parison has been made with the well-known existing methods. Numerical tests is given for some problems, like, soliton, soliton-soliton, soliton anti-soliton and the break-up. The exact solution for the single soliton is used to asses the performance, of these method

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