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On the Grid Technique by Approximating the Derivatives of the Solution of the Dirichlet Problems for (1+1) Dimensional Linear Schrodinger Equation

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Abstract : Four point implicit schemes for the approximation of the first and pure second order derivatives for the solution of the Dirichlet problem for one dimensional Schrodinger equation with respect to the time variable t were constructed. Also, special four-point implicit difference boundary value problems are proposed for the first and pure second derivatives of the solution with respect to the spatial variable x. The Grid method is also applied to the mixed second derivative of the solution of the Linear Schrodinger time-dependent equation. It is assumed that the initial function belongs to the Holder space C^{8+a}, $0 < \alpha < 1$, the Schrodinger wave function given in the Schrodinger equation is from the Holder space $C_{x,t}^{6+a, 3+a/2}$, the boundary functions are from C^{4+a}, and between the initial and the boundary functions the conjugation conditions of orders $q = 0,1,2,3,4$ are satisfied. It is proven that the solution of the proposed difference schemes converges uniformly on the grids of the order $O(h^2 + k)$ where h is the step size in x and k is the step size in time. Numerical experiments are illustrated to support the analysis made.

Keywords : approximation of derivatives, finite difference method, Schrödinger equation, uniform error
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