The Hong Kong University of Science and Technology

Department of Mathematics

MPhil THESIS EXAMINATION

Fast Huygens Sweeping Methods for a Class of Nonlocal Schr\"odinger Equations

By

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ABSTRACT

In this thesis, we examine a class of nonlinear Schr\"odinger equations containing a nonlocal potential and solve them using the fast Huygens sweeping method. The nonlocal mutual contact among particles is governed by the nonlocal potential, which is modeled by the Gaussian convolution of the intensity. Additionally, we extend the approach for the linear Schr\"odinger equation in the semi-classical regime found in Leung-Qian-Serna (Methods and Applications of Analysis, Vol. 21 (2014), No. 1) to the nonlinear situation involving nonlocal potentials. Fast Fourier transform is utilized to handle the nonlinear nonlocal interaction term in FHSM by applying either Strang's operator splitting or Lie's splitting. Consequently, the computional cost of the algorithm will be the same as that of the linear cases. The two operator splitting approaches obtain first-order and second-order accuracy, respectively, in numerical examples, one-, two-, and three-dimensional examples will also be used to illustrate the effectiveness of the suggested approach. Furthermore, we conduct an additional examination of the particle's scattering effect, which is associated with the nonlocal, nonlinear Schrödinger equation.

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Thesis Examination Committee

Chairman	**:**	**Prof. Yang XIANG, MATH HKUST**
Thesis Supervisor	**:**	**Prof. Shing Yu LEUNG, MATH/HKUST**
Member	**:**	**Prof. Zhichao PENG, MATH/HKUST**

(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).