NUMERICAL SOLUTIONS TO THE NONLINEAR SCHRODINGER EQUATION

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1. The research problem

The Schrödinger equation is the most fundamental partial differential equation (PDE) in quantum physics. This project will focus on its classical limit in certain special cases, namely the Nonlinear Schrodinger equation (NLS) and the modified NLS (mNLS). These equations have applications to propagation of light in nonlinear optical fibers and gravity waves on the surface of deep zero-viscosity water among many others.

The main challenge is that solving PDEs by hand is extremely difficult. In this project we will work towards finding *numerical* solutions to PDEs: we calculate approximate solutions on a computer and plot the results. Our goal is to spot patters and make conjectures about the behavior of solutions in particular special cases.

Depending on progress and interest, we might work on a wave turbulence problem that involves numerically solving the kinetic equation.

2. The work we do

To make progress on the project we will learn the fundamentals of PDEs, at the level we need to start solving them numerically. From that point, much of the work will involve designing a calculation and visualization of numerical solutions.

Recommended background: a course in multivariate calculus, and course in ordinary differential equations (ODEs). Training in numerical methods will be a big plus.