Solving Differential Equations: Green's Functions Approach

Lecture 1 – Graduate Talk

Hyperbolic-Parabolic Conservation Laws

Several basic physical models are dissipative, but not uniformly parabolic. These include the Navier-Stokes in gas dynamics, the magnetohydrodynamics, and viscoelasticity equations. We will introduce the Green's function approach for studying the nonlinear waves for these models, starting with the simple "p-system."

Lecture 2 – Colloquium

Shock Waves for Finite Differences

There have been important progresses on computations of shock waves. On the other hand, quantitative analysis of even the basic schemes such as the Lax-Friedrichs and Godunov schemes is lacking. We will study the construction and stability of traveling waves for these schemes. The pointwise Green's function approach reveals intricate small divisor problem.

Lecture 3 – Colloquium

Nonlinear Waves for Boltzmann Equation

The Boltzmann equation in kinetic theory can model both the particle and fluid aspects of the gas motions. As a consequence, the Boltzmann equation can model important thermal and geometric boundary phenomena that the traditional Navier-Stokes and Euler equations fail to model. We will construct the Green's functions and use them to study the nonlinear interior waves and the boudary Knudsen layers.