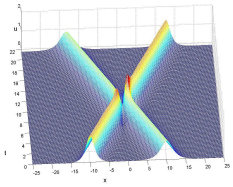
Math 395 Nonlinear Partial Differential Equations

TR 1:00--2:15, Lafayette L308



Reference book:

J. Yang, *Nonlinear Waves in Integrable and Nonintegrable Systems* (SIAM, Philadelphia, 2010).

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Office hours: T 11:30am-12:30am; F 3:00pm-4:00pm. Additional time by appointment.

Homework: homework problems will be given on irregular basis. Computers will be used for some of the problems.

Exams: No. But a final-term project will be assigned.

Grading: homework: 50%; project: 50%

Topics (tentative):

1. Linear wave equations; dispersion; group velocity;
2. Derivation of some nonlinear partial differential equations including the Korteweg-de Vries Equation (KdV) equation and the nonlinear Schroedinger (NLS) equation in water waves and nonlinear optics;
3. Numerical methods for solving the nonlinear partial differential equations: the pseudo-spectral method and the split-step method
4. The inverse scattering transform method;
5. Solitons; soliton collisions; N-soliton solutions;
6. The soliton perturbation theory and applications to nonlinear optics;
7. Solitary waves in nonintegrable equations;
8. Linear stability theory of solitary waves; Vakhitov-Kolokolov stability criterion;
9. Weak interactions of solitary waves;
10. Transverse instability of line solitary waves;
11. The (2+1)D nonlinear Schroedinger equation; the virial theorem; critical collapse.

Pre-requisites: elementary knowledge of linear ODEs and PDEs (Math 230, Math 339 or equivalents) and numerical analysis (Math 237 or equivalent).