Numerical Solution of Partial Differential Equations
Spectral Methods

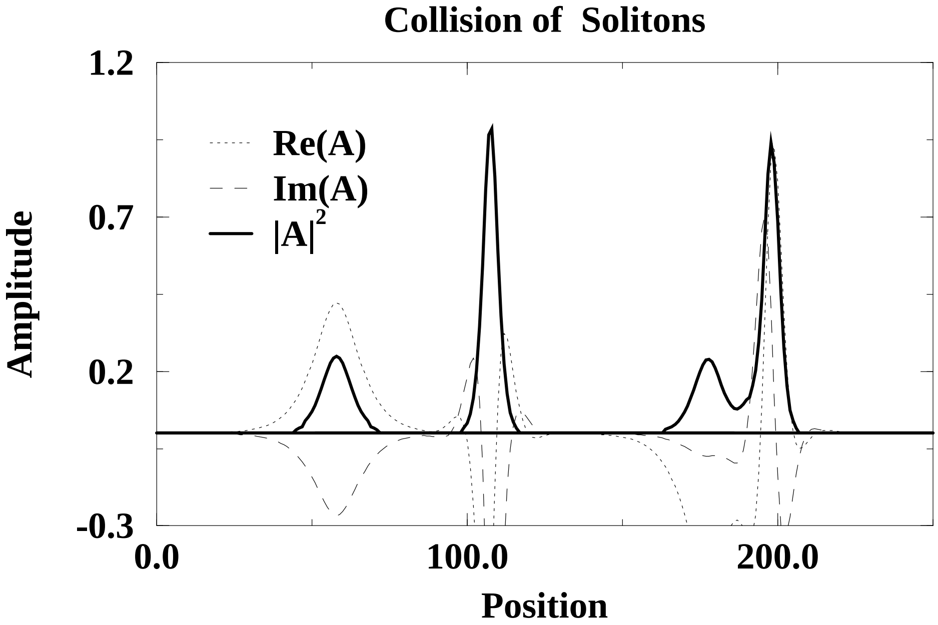
ESAM D-46-2

Winter 1997

Hermann Riecke

In this class spectral methods will be discussed for the solution of partial differential equations. In two projects the students will implement Fourier- and Chebyshev-spectral methods and will investigate their properties.

The case study for the Fourier method will employ the nonlinear Schrödinger/Ginzburg-Landau equation, which describes, for instance, phase transitions, soliton pulses in fiber optics, weakly nonlinear waves in general,... In the Chebyshev project a set of equations will be solved which describe oscillatory and pattern-forming chemical reactions. In both projects graphical animation will aid the developing of the codes as well as the interpretation of the results. In particular the Fourier-spectral code will enable the students to solve efficiently a large variety of other partial differential equations without too much modification.



The technical topics to be discussed will include:
Approximation properties of Fourier and Chebyshev series, pseudo-spectral *vs.* Galerkin methods, review of time-stepping methods (stability), initial-boundary-value problems, Chebyshev-tau method, iterative methods (implicit schemes, preconditioning), higher-dimensional problems.

Strongly recommended book:
C. Canuto *et al.*, *Spectral Methods in Fluid Dynamics*, Springer.

Time and Place: TuTh 2:30-4:00 in A110 (computer projection room)

Do you have any questions?
Phone: 491-8316, e-mail: h-riecke@nwu.edu