Mathematical Models of Wave Propagation

In the physical world, the propagation of waves represents one of the fundamental mechanisms for the transport of energy. Historically, the early development of the mathematics of waves followed scientific advances in optics, elasticity, hydrodynamics and acoustics. Modern wave theory finds everyday use in applications such as laser technology, earthquake detection, climate prediction and ultrasound imaging. The central theme of this class will be the analysis and computation of wave behaviour in partial differential equations that arise in models of physical wave processes.

Beyond the familiar hyperbolic wave equation and its simple solutions of translation, a rich theory of linear wave propagation emerges from the effects of dispersion and spatial dimension. In dispersive systems, the concepts of phase and group velocity are fundamental for understanding the propagation characteristics of waves. The theory of rays and Huygens' principle of wavefronts are naturally obtained as the behaviour of waves in the limit of high frequency. These ideas provide the basic mathematical tools for investigating models for common wave phenomena:

- reflection, refraction & focussing,
- diffraction, interference & scattering,
- waveguides & resonance.

Nonlinearity adds further avenues for complexity — solitary waves, instabilities and shocks are just a few examples which are described through elementary nonlinear wave equations.

Professor: David Muraki, office K10538, phone 604.291.4814

Lectures: Monday & Wednesday at 9:30-11:20am in AQ 5006

Office Hours: Tuesday 3:00-5:00pm, or by special arrangement (phone/e-mail)

Reading: *Wave Motion*, J. Billingham & A.C. King, Cambridge (2000)
not available — options to be discussed

Webpage: visit *www.math.sfu.ca/∼muraki* & follow class link
updated weekly — assignments, computing demos & announcements
link to online notes from main library

Communication: webct-based discussion postings as primary class e-mail
muraki@sfu.ca: private class-related e-mail correspondence only
muraki@math.sfu.ca: urgent correspondence only please

Computing: Matlab is the recommended computing environment
lecture & homework scripts will be posted on class webpage
Matlab accessible via campus network & assignment lab (AQ3144)

Responsibilities: weekly assignments (≈ 60%)
active participation in class & webct discussions
final poster projects (≈ 40%)