Math 418 • Partial Differential Equations • Fall 2010

PDEs: Solutions, Properties & Contexts

Many areas of mathematics and the sciences involve functions of more than one variable that are defined as a solution to an equation relating its partial derivatives. This introduction to the theory of partial differential equations (PDEs) begins with a study of the three basic linear prototypes, known as:

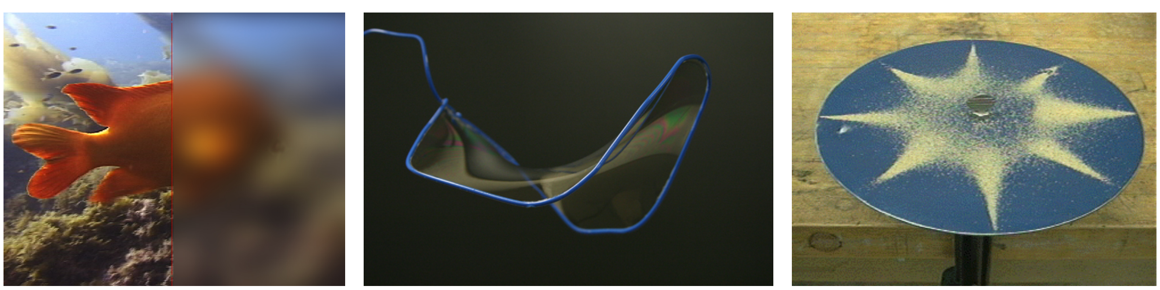
- the Laplace & Poisson equations,
- the diffusion equation, and
- the wave & Helmholtz equations.

The linear theory is developed by combining familiar ideas from multi-variable calculus, linear algebra, and ordinary differential equations. In addition to developing analytical methods for the solution and understanding of these equations, more abstract notions of existence, uniqueness, and solution properties will be explored. The study of these PDEs will also include a discussion of their origins and applications beyond mathematics. For instance, probabilities can be understood in terms of diffusion; sound propagation can be described by waves; and gravitational forces are derivable from Poisson potentials.

Additional topics include: Fourier series and transform methods, nonlinearity and shock waves, calculus of variations, and optimization.

Calendar course prerequisites: Math 314/Phys384. Math 251 (multi-variable calculus) and Math 310 (ordinary differential equations) contain many of the foundational ideas. Also, Math 242/320 and Math 322 are advantageous for a background in proofs of theorems. Some familiarity with Maple and/or Matlab computing is helpful.

Further information & updates: www.math.sfu.ca/∼muraki



These images are pictorializations of the three basic linear PDEs. The Gaussian blurring of images is a 2D application of diffusion. The slight geometrical distortions of a soap film can be described by the Laplace equation. An acoustic mode of a flat plate is visualized by a Chladni pattern that is related to solutions of the Helmholtz PDE.