Math 314 • Boundary Value Problems • Spring 2009

Introduction to Partial Differential Equations: Theory, Computing & Graphics

What we perceive of the world around us are variations of physical effects (like heat, sound & light) over space and time. Partial differential equations (PDEs) are the mathematical language for describing this sensory landscape in terms of continuous functions. This year's course contains the core of the traditional *boundary value problems* curriculum, but will also introduce the computer graphics and numerical computational tools associated with the analysis of PDEs and their solutions.

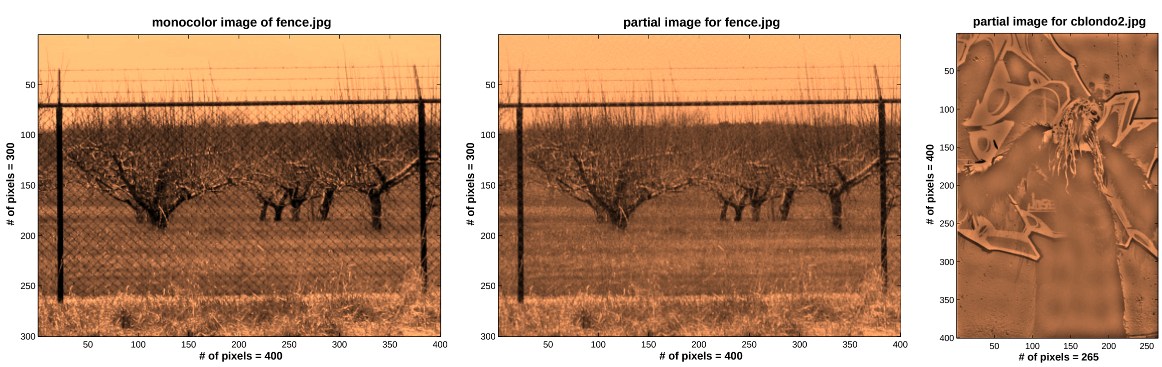
Central to the theory of linear PDEs are the Fourier series and Fourier transform. The numerical implementation of the Fourier series, the *fast Fourier transform* (FFT), is one of the most important numerical algorithms in scientific computing. The trio of elementary PDEs: the potential, heat and wave equations will be introduced through their Fourier solutions. The generalization of these to higher dimensions will naturally lead to the "special" functions, such as the Bessel function and spherical harmonics.

The computational tools will be developed from numerical routines based upon the linear algebra of matrices and vectors. The numerical computing and graphics will be performed through the modification of downloaded Matlab scripts and Maple worksheets.

Textbook: *Introduction to Partial Differential Equations: a computational approach*, Tveito & Winther, Springer-Verlag (1998) & SFU Library electronic resource.

Prerequisites: Math 252 or 254 & Math 310; or instructor's permission.

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



The images above were two of last year's submissions to the in-class art show of Fourier-processed images. The first two images on the left illustrate the before-and-after of a fence that has been numerically stolen. The rightmost image is a fashion shot under a high-pass filter.