

Spring 2007 Course  
**6.342 Wavelets, Approximation, and Compression**

Instructor: Vivek Goyal (vgoyal@mit.edu, <http://www.rle.mit.edu/stir/>)  
Lectures MW 11:00-12:30, 1-150  
Course Units: 12 (3-0-9) (Grad H credit)

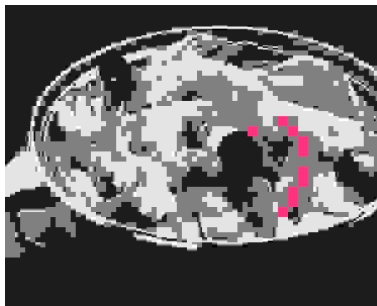
**Overview:** Wavelet transforms and associated techniques have made the transition from esoteric research topics to essential tools in signal processing. This course covers the mathematical foundations of wavelets while maintaining an emphasis on the efficiently-computed discrete-time signal representations that are most often used in practice. Applications to approximation and compression are emphasized throughout.

Image compression example:

Images from <http://www.imagepower.com/technology/jpeg2000/compare/food.html>



Original: 844 kbytes



DCT-based compression: 3 kbytes



Wavelet-based compression: 3 kbytes

**Prerequisites:** 18.06; and 6.341 or 6.450. Inquire with the instructor.

**Catalog description:** Hilbert space formulation of continuous-time and discrete-time signals. Sampling. Orthogonal and biorthogonal signal expansions. Uncertainty principles and the time-frequency plane. Two-channel filter banks, iterated filter banks, and discrete wavelet transforms. Multiresolution analysis. Wavelet bases, regularity, approximation properties, and nonlinear approximation. Basics of quantization and source coding. Compression, denoising, and other image processing using wavelets. Advanced topics from the current research literature.

**Course structure:** The course will have a small number of conventional homework assignments, computation problems to be completed with MATLAB, a midterm exam, and a research-oriented final project (no final exam). Projects must use the techniques of the course but may be in any area. The project may be completed individually or in small groups.

**Main text:** *The World of Fourier and Wavelets: Theory, Algorithms and Applications* by Martin Vetterli, Jelena Kovačević and Vivek K Goyal (manuscript with anticipated publication in 2007). See <http://FourierAndWavelets.org> for additional information.