M676 Geometric Data Analysis

Problem Set Four

Friday, April 21, 2006

1 Theory

1. Text problem 6.4.
2. Text problem 6.5.
3. Write one level of the pyramidal decomposition algorithm using the Haar wavelet transform as matrix multiplication. Compare and contrast this with matrix representation of the Discrete Fourier Transform.
4. This question concerns the *by hand* implementation of the wavelet pyramidal decomposition and reconstruction of the simple Haar vector $(-1, -1, 2, 4)$.
   a) Compute the scaling coefficients and wavelet coefficients to as many levels as possible.
   b) Draw the reconstructed functions in the scaling and wavelet subspaces at each level (not just the scaling/wavelet coefficients).
   c) Reconstruct the function with the contents of the second finest wavelet subspace omitted.

2 Computing

You may either use the matlab subroutine dwt for this assignment or write the code yourself. If you choose to use matlab, then type help dwt in matlab for additional information on how this function should be used.

1. A noisy data vector of length 1024 is available on the class website for this problem. Download it and plot it.
2. Compute the DWT of this function using matlab. Plot the resulting functions at each level both in the wavelet and scaling spaces.
3. Compute the FFT using matlab and plot the amplitude spectrum.

4. Compare the FFT and DWT as tools for filtering the noise in the signal. You should experiment by zeroing what seem to be reasonable coefficients in the transform domain followed by reconstruction.