November 2005

Optional Home Assignment V for Wavelet Course 2005 fall

Handed out:November 15,
Handing in before December 16.
The continuse wavelete transform

1. Create a matlab function cwavtrans:

   $$[\text{wcoeff}] = \text{cwavtrans(signal,scales)}$$

   which computes the continous wavelet transform of the real column vector signal using the complex morlet wavelet. over the scales given in the column vector scales.

2. apply this transform on some given signals quitar.wav and noisyquitar.wav given in the webdirectory

   http://www.math.kth.se/ jostromb/5B1308/

The complex morlet wavlet is given by the formlula[

$$\psi(x) = \frac{d}{dx}\exp\{-x^2\}\exp\{iAx\}$$

where A is a positve number. We will choose $A = 5$.
The gaussian function $\exp\{-x^2\}$ is rapilcy decrasing as $|x|$ increases and we may with good accuracy approximate it by 0 when say $|x| \geq 6$.
Question: how large is its value for $x = 6$.
Let s_{max} be the maximal scale in the given input. Represent the functions

$$\frac{1}{\sqrt{s_j}}\psi(x/s_j)$$

sampled on integers on the interval $[-6s_{max}, 6s_{max}]$ as a matrix Ψ one column for each scale. Notify which row in the matrix that correspond to the point zero on the interval.
The derivative in the formula for the Morlet wavelet should be done by taking a simple differens between neighboring sample points.
It now only remains to convolve the signal (a column vector) by each coloumn vector in in the matrix Ψ. Keep track of where the "zero row" is in the Ψ .

Matlab has some function for convolution but the are rather slow. I plan to provide a faster function conv_fft(signa,matrix) on the course web site. It is a so called mex file conf_fft_float.xxxx (where xxx is specific for the operatave system)
for Windows xxx=dll, for Sun:xxx=mexsol. for Linux xxx=mexsglx.
Those file hidden with a codename.
Some signals with be but up on the web site. Compute the contious wavelet coefficents for some set of signals (ex. guitar.wav, noisy,guitar.wav), The output will be a matrix of complex numbers. Plot their abslute values in a color diagram by the function imagesc().