Lab 2 – Part 1
-1D Orthogonal Wavelet Transform –
Signal compression

Aim of this practical work:
- Plot of 1D and 2D orthogonal wavelet coefficients for different functions and interpretation.
- Use of the toolbox WaveLab, in the directory « Orthogonal ».

This Lab is divided in 2 parts:
- Part I: computation of orthogonal wavelet coefficients for different functions and interpretation using the directory "Orthogonal"
Compression of 1D function by thresholding, estimation of the compression error.
- Part 2: 2D, visualization of the wavelet coefficients, compression, Image denoising –

- Selection of articles for the final projects (binôme for MMIS, individual for MSIAM) **: reference of the article (title, authors, journal, year)**

-I- Connection to Matlab
Matlab is available on the machine "pcserveur.ensimag.fr" (and also on other machines)

-II - Toolbox WaveLab

The command
>> help Wavelab850
gives the list of Wavelab directories. For example:

>> help Orthogonal
gives the list of matlab functions in this directory, related to the orthogonal wavelet transform (see also "Meyer").

>> help Datasets
provides examples of 1D signals or 2D Images (with a Data fabricator or from a dataset)

>> help DeNoising
Tools for DeNoising Signals with White Gaussian Noise

- III – Orthogonal Wavelet Transform using the directory "Orthogonal" of Wavelab

Steps for an orthogonal wavelet transform:

1. Choose the wavelet (ie the corresponding filters) (= filters 'qmf' h_n and g_n of the course)
2. "FWT" and "FWT2" = Fast Wavelet Transform using qmf -> choose the periodic FWT !

Find also the functions which allows the visualization of (1D) wavelet coefficients !

3 - "IFWT" and “IFWT2” = Inverse FWT : reconstruct the function from its wavelet coefficients.

Exercise 1 (**to do and to send me at the end of the session, in binôme**)

1- Write a program which:

1. Plot the scaling functions and wavelets for a given family

- Run your program for different examples of Wavelets and scaling functions. (explain the interest/properties of each family)

2- Write a program which:

i. Computes and plot the **1D** wavelet coefficients of a given **function.**
ii. Compress the coefficient vector and reconstruct a compressed function (describe the compression method).
iii. Compute the l2-error between the original function and the compressed function.

- Run your program for different examples of functions (use commands from Datasets), and plot on a same graph the function, its wavelet coefficients, and the compressed function (compute the compression factor).
- Plot the curves of the error with respect to the compression factor (or the number of retained coefficients), in Log-Log scale. What do you observe?

Exercise 2 (**to do and to send me at the end of the session**)

1- Write a program which:

iv. Computes and plot the **2D** wavelet coefficients of a given **image**
v. Compress the coefficient matrix and reconstruct a compressed image

- Run your program for different examples of images (use commands from Datasets), and plot the image, its wavelet coefficients, and the compressed image ; compute the compression factor.

2- Write a program which:

vi. Generates a noisy image form an original image (use GWN2, choose different levels of noise).
vii. Denoise the noisy image, using the function IdealWavDenoise from the directory Denoising.

Explain what IdealWavDenoise do !

Choice of the article for your project (individual for MSIAM students) : to be completed

At the end of the session, write an email to Valerie.Perrier@grenoble.fr with:

A **pdf** file, with :
--- the figures
--- the matlab commands of your programs.

--- the title of the article chosen for the project.

Until January 9, write a summary and a plan for your project (One page max) and sent it to me.

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