Università degli Studi di Brescia

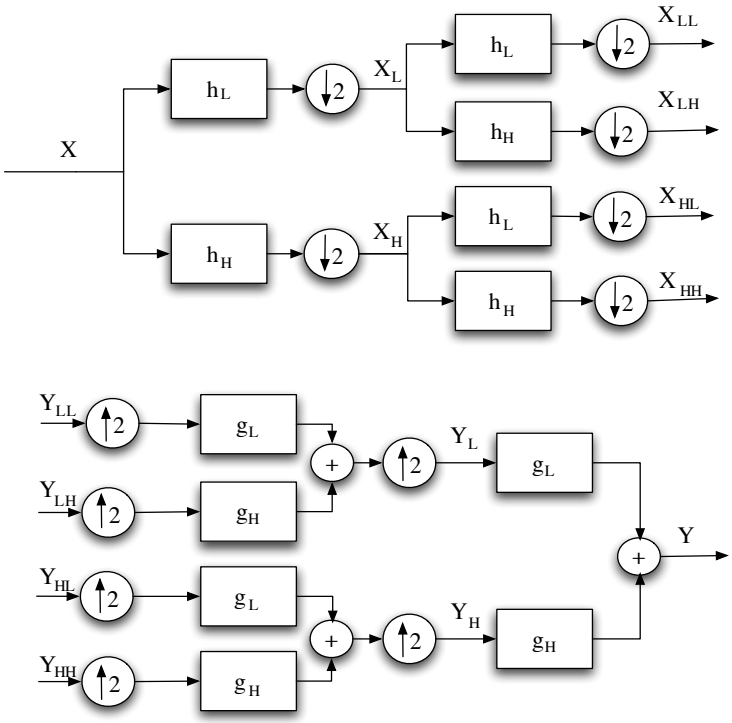
Multimedia Communication Services
Lab experience n. 8

Sub-band filtering

Consider the filter bank with the following perfect reconstruction Haar analysis and synthesis filters

$$h_L = [\frac{\sqrt{2}}{2} \quad \frac{\sqrt{2}}{2}] \quad h_H = [\frac{\sqrt{2}}{2} \quad -\frac{\sqrt{2}}{2}] \qquad g_L = [\frac{\sqrt{2}}{2} \quad \frac{\sqrt{2}}{2}] \quad g_H = [-\frac{\sqrt{2}}{2} \quad \frac{\sqrt{2}}{2}] \tag{1}$$

Consider then the separable application of these filter bank to an image according to the following scheme for horizontal and vertical filtering and sub-sampling



1. Implement the analysis bank by filtering the signal X first by columns, so obtaining X_L and X_H, and then filtering by rows those two signals to obtain X_{LL}, X_{LH}, X_{HL}, X_{HH}.

2. Display the four sub-bands X_{LL}, X_{LH}, X_{HL}, X_{HH} and observe the different content of each sub-band.

3. Implement the synthesis bank and check that the filter bank is perfect-reconstruction.

4. Evaluate the quality of the image obtained by only using the LL sub-band in the synthesis phase (quantize the remaining sub-bands to zero).

5. Iterate the sub-band analysis and synthesis process on the LL sub-band, and repeat the experiment of the previous two points.

Bonus: Apply a uniform (non-zero) quantization to different sub-bands and study its effect on the quality of the reconstructed image.