Figure 4: Wavelet-based compression procedure involving a weighting prior the encoding stage.

Then, the resulting distortion in the spatial domain $\hat{D}_s$ is evaluated by taking the inverse transform. Finally, the corresponding subband weight can be estimated as follows:

$$w_{j+1}^{(o)} = \hat{D}_s \times 4^{j+1} \frac{\sigma_{j+1}^{(o)}}{(\sigma_{j+1}^{(o)})^2}. \quad (28)$$

This weighting step is very important since standard bit allocation algorithms assume that the quadratic distortion in the wavelet domain is equal to that in the spatial domain, which is not true in the case of biorthogonal wavelets [56]. Therefore, the filters resulting from the first choice of $\kappa_{j+1}^{(o)}$ are suboptimal in the sense that they do not take into account the weighting procedure. For this reason, it has been noticed on some experiments (as it can be seen in Section 6) that the basic optimization technique does not achieve the best coding performances.

Thus, a more judicious choice of $\kappa_{j+1}^{(o)}$ should take into account the weighting procedure applied to the wavelet coefficients before the entropy encoding process. Furthermore, if in the general formula in Eq. (9), we consider the case of $\beta_{j+1}^{(o)} = 1$, the differential entropy of $X_{j+1}^{(o)}$ multiplied by $\sqrt{w_{j+1}^{(o)}}$ becomes:

$$\frac{1}{M_j N_j \alpha_{j+1}^{(o)}} \sum_{m=1}^{M_j} \sum_{n=1}^{N_j} |x_{j+1}^{(o)}(m,n)| + \log_2 \left(2\alpha_{j+1}^{(o)} \sqrt{w_{j+1}^{(o)}}\right) \quad (29)$$

where $\alpha_{j+1}^{(o)}$ can be estimated by using a classical maximum likelihood estimate. Thus, it can be observed from Eq. (29) that the first term of the resulting entropy, which corresponds to a weighted $\ell_1$-norm of $x_{j+1}^{(o)}$, is inversely proportional to $\alpha_{j+1}^{(o)}$. Consequently, in order to obtain a criterion (Eq. (16)) that results in a good approximation of the entropy (29), a more reasonable choice of $\kappa_{j+1}^{(o)}$ will be as follows:

$$\kappa_{j+1}^{(o)} = \frac{1}{\alpha_{j+1}^{(o)}}. \quad (30)$$