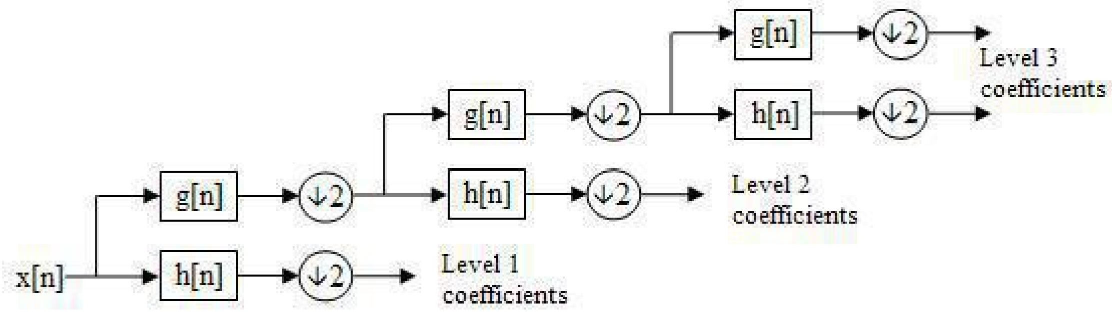
Discrete 1-D wavelet decomposition

MatDeck's function, wavedec(), performs multilevel wavelet decomposition using wavelet filters which are specified by the user. The input arguments of the function are: input signal which can be a row vector or a column vector, integer level, value, and the string which specifies the type of wavelet filter that is to be used. Multilevel wavelet decomposition is represented as a filter bank displayed in the following figure.



The wavelet decomposition is performed by filtering the input signal at certain levels by a low-pass filter denoted as g[n] producing the approximation coefficients at a given level, and a high pass filter denoted as h[n] producing the detail coefficients. After that, the coefficients are downsampled by two and then fed to the next level. The function, wavedec(), returns the detail coefficients of each level, concluding with the detail coefficients of the highest level. These coefficients are all of different lengths, and they are combined in a special vector structure of *n*+1 column vectors which are all different lengths, where *n* is the decomposition level. The function also returns the bookkeeping vector which contains the number of coefficients by level, including the input signal. The number of coefficients is needed for appropriate reconstruction. The next example shows how the function is used on a simple signal.

testS := $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

level := 3

wname := "db2"

TSw := wavedec(testS , level , wname)

$$TSw = \begin{bmatrix} \begin{bmatrix} -0.069 \\ 0.423 \\ 0 \end{bmatrix} & \begin{bmatrix} -0.258 \\ -0.113 \\ 0 \end{bmatrix} & \begin{bmatrix} -0.046 \\ -0.137 \\ 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 0.837 \\ -0.129 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 3 \\ 3 \\ 4 \\ 6 \\ 10 \end{bmatrix} \end{bmatrix}$$

Signal reconstruction

The signal is reconstructed by using the waverec() function. The arguments of the filter are the vector structure which is obtained by the decomposition and wavelet name which is used for decomposition.

$testSr := \mathrm{waverec}(TSw, wname)$

$testSr^T = \begin{bmatrix} 1 & 0 & 2.776e-17 & -2.082e-17 & 3.592e-18 & 1.340e-17 & 3.110e-18 \end{bmatrix}$

Although there are values at every position, these values are very small and can be considered negligible. Therefore, we can say that we have the perfect reconstruction.