The Discrete Time Wavelet Transform: Its Discrete Time Fourier Transform and Filter Bank Implementation

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Abstract

Viewing the discrete time wavelet transform DTWT[m,n] of a sampled signal s(nT) as a sequence in n, a closed form expression is derived for its Discrete Time Fourier Transform (DTFT) $D^{(m)}\left(e^{j\omega}\right)$ in terms of the DTFTs of the sampled mother wavelet $\psi(nT)$ and sampled signal s(nT). Next an expression is derived for the output $Y^{(m)}\left(e^{j\omega}\right)$ of a filter bank defined by the digital filters a[n] and b[n] and excited by s(nT). The filter a[n] emerged as an ideal low-pass filter and the filter b[n] turned out to be a time reversed and complex conjugated version of the sampled mother wavelet $\psi(nT)$.