

Problem Set VII

1. Suppose that $H_0(e^{j\omega})$ is an ideal low-pass filter and $H_1(e^{j\omega})$ is an ideal high-pass filter. Both filters have cut-off frequency at $\omega = \frac{\pi}{2}$ and are periodic with period 2π .

Find the frequency and time responses of the resulting scaling and the wavelet function, i.e., $\Phi(\omega)$, $\Psi(\omega)$, $\phi(t)$, $\psi(t)$.

Simulate this design in Matlab. Plot the approximate scaling and wavelet function in both time and frequency.

2. Suppose that we have K vanishing moments in an orthonormal wavelet system, prove that

(a) $\left\{ \frac{d^k}{dz^k} H_1(z) \right\} \Big|_{z=1} = 0, \quad \text{for } k = 0, 1, \dots, K - 1.$

(b) $\sum_n n^k h_1[n] = 0, \quad \text{for } k = 0, 1, \dots, K - 1.$

(c) $\int t^k \psi(t) dt = 0, \quad \text{for } k = 0, 1, \dots, K - 1.$

Due date: **Friday Nov. 17** in class