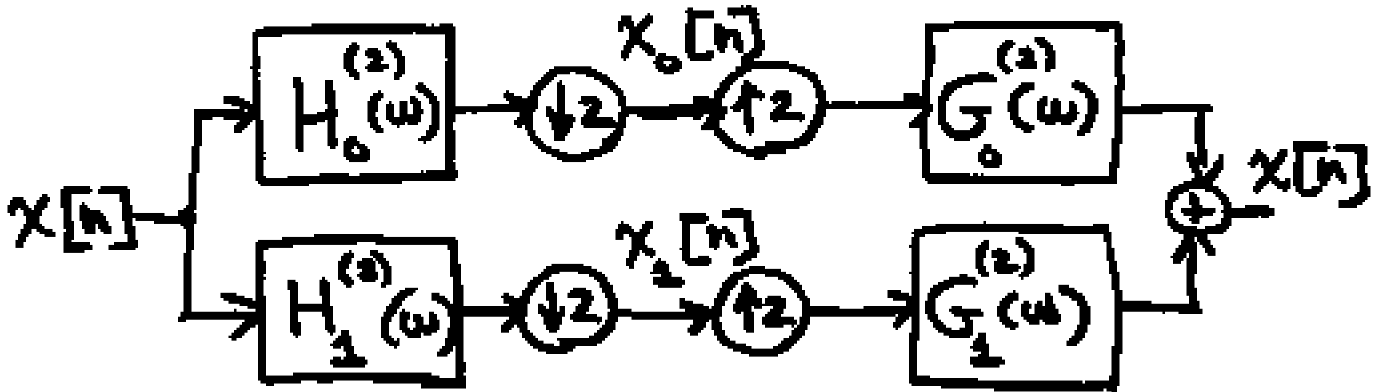
EE648 (CC761-M) DSP II
Session 24 (Live: 4/8/99)

- <u>Announcement</u>: Session 26 is canceled.

- <u>Outline</u>
  - Prelude to DT Wavelets
    - Chap. 11.4 of V. Text

- Recall: 2 channel PR filter bank



- view as an expansion of $x[n]$ in terms of a set of orthonormal basis functions

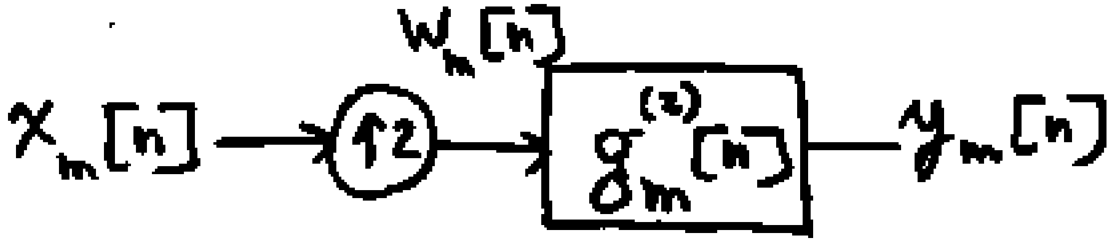
• assuming ideal 2-channel QMF

$$x[n] = \sum_{m=0}^{1} \sum_{k=-\infty}^{\infty} x_m[k]\, g_m^{(2)}[n-2k]$$

• wavelet coefficients:

$$x_m[n] = \sum_{k=-\infty}^{\infty} x[k]\, h_m^{(2)}[2n-k]$$

$m = 0, 1$



$$w_m[n] = \sum_{k=-\infty}^{\infty} x_m[k]\,\delta[n-2k]$$

$$y_m[n] = w_m[n] * g_m^{(2)}[n]$$
$$= \sum_{k=-\infty}^{\infty} x_m[k]\, g_m^{(2)}[n-2k]$$

- Orthonormality of wavelet basis:

$$\sum_{n=-\infty}^{\infty} h_m^{(2)}[n-2k]\, g_\ell^{(2)}[n-2i]$$

$$= \delta[m-\ell]\,\delta[k-i]$$

- referred to as bi-orthogonality

- Compare to DFT basis:
- basis fns.: $g_k[n] = e^{j 2\pi \frac{k}{N} n}$,

$k = 0, 1, \ldots, N-1$

$n = 0, 1, \ldots, N-1$

- if $x[n] \neq 0$ only for $n = 0, 1, \ldots, N-1$,

$$x[n] = \sum_{k=0}^{N-1} \left(\frac{1}{N} X_N(k) \right) g_k[n]$$

- orthonormality of DFT basis:

$$\sum_{n=0}^{N-1} g_k[n]\, g_\ell^*[n] = N\,\delta[k-\ell]$$

$$\frac{1}{N} X_N(\ell) = \sum_{n=0}^{N-1} x[n]\, g_\ell^*[n]$$