EE648 (CC761-M) DSP II

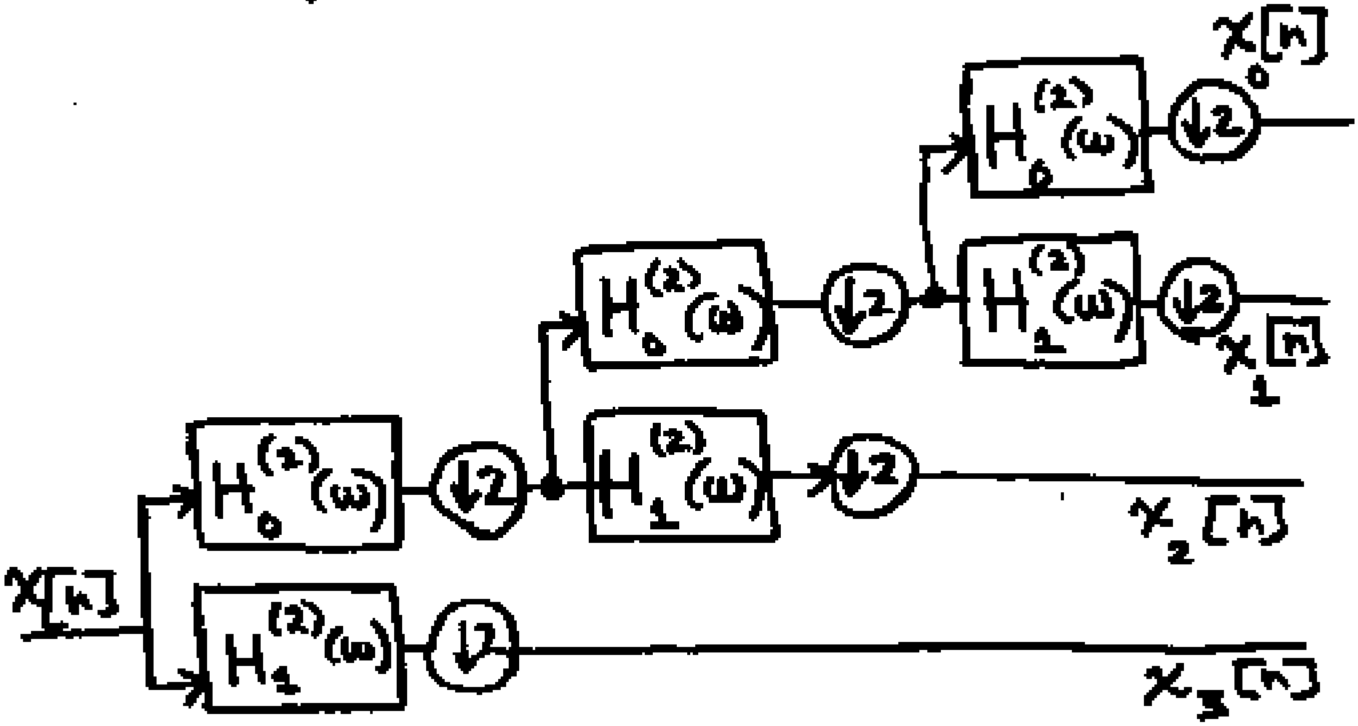
Session 25 (Live: 4/13/99)

- Reminder: Session 26 canceled
  - Work on Homework 6

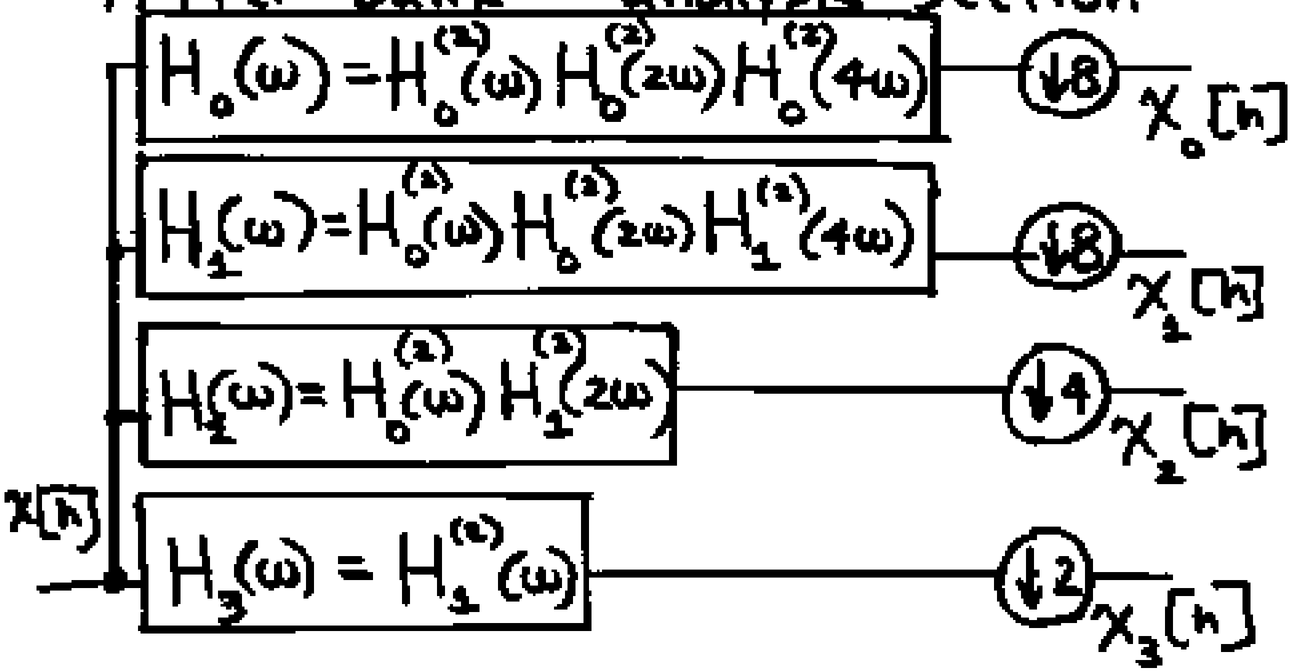
Outline:

- Multiresolution, Tree-Structured PR Filter Bank –
  - Relation Dyadic Discrete-Time Wavelets – Chap. 11.4 of V. Text

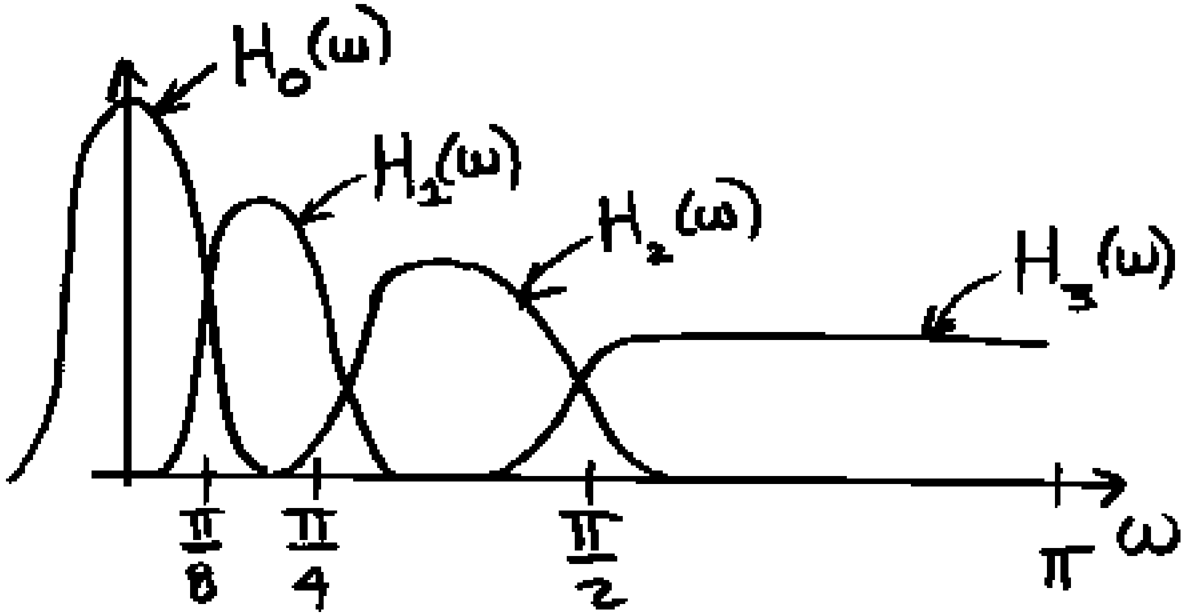
- Discrete-Time Dyadic Wavelets
- e.g. 3-level binary tree-structured QMF Bank



• Equivalent $M=4$ channel nonuniform filter bank — analysis section



- Octave Passbands :



• in time-domain:

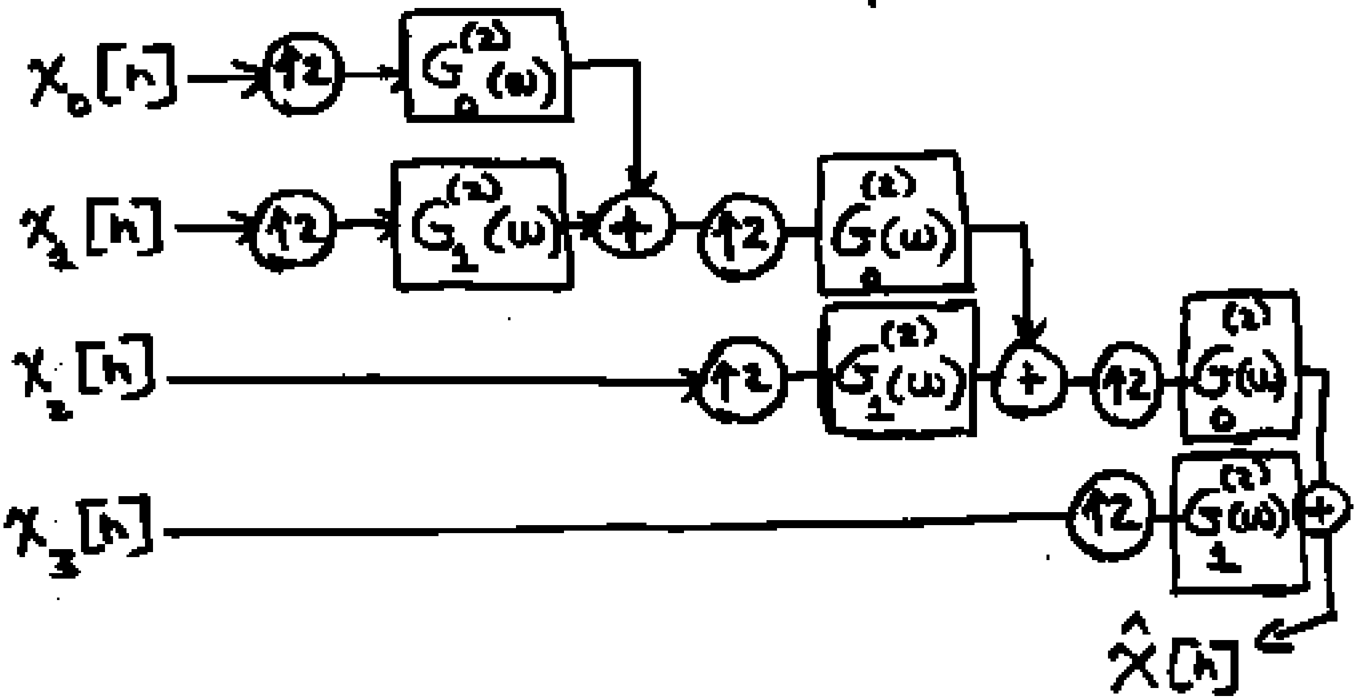
$$x_0[n] = \sum_m x[m]\, h_0[2^3 n - m]$$

$$x_1[n] = \sum_m x[m]\, h_1[2^3 n - m]$$

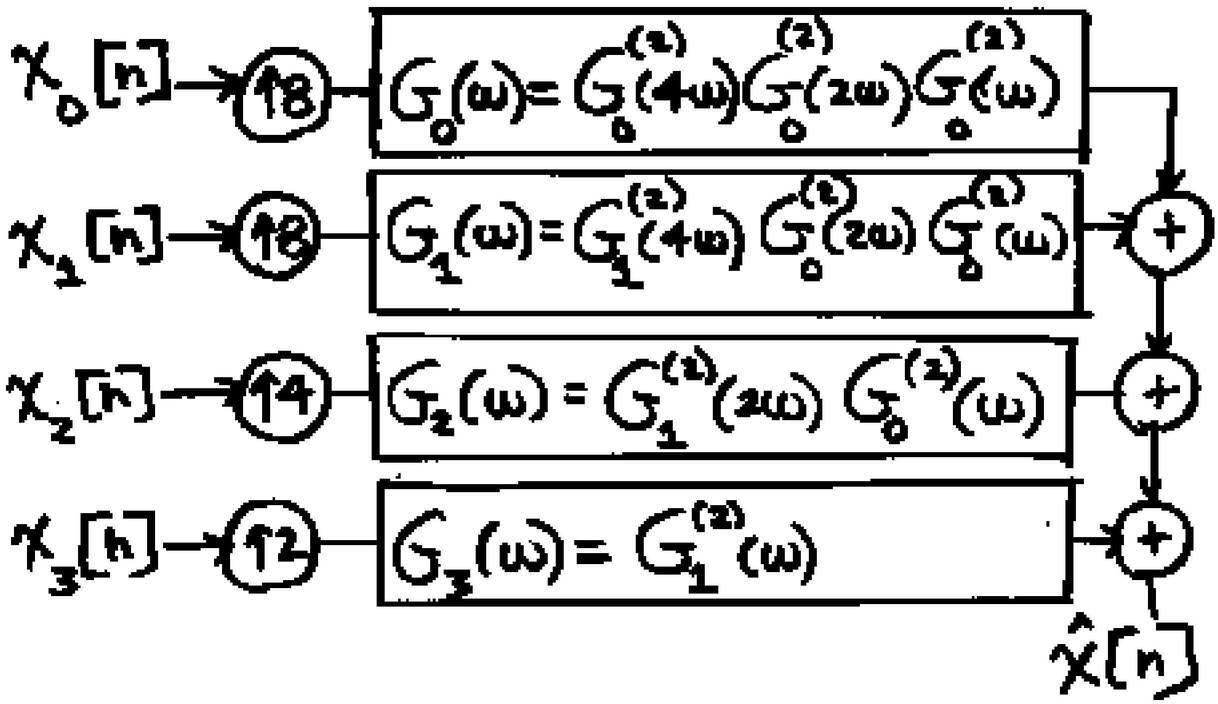
$$x_2[n] = \sum_m x[m]\, h_2[2^2 n - m]$$

$$\underbrace{x_3[n]}_{\text{wavelet coefficients}} = \sum_m x[m]\, h_3[2n - m].$$

- Synthesis section – Tree-Structured Implementation



• Equivalent M=4 channel Nonuniform PR Filter Bank - Synthesis Section



$$
\begin{aligned}
\hat{x}[n] = & \sum_m x_0[m]\, g_0[n - 2^3 m] \\
& + \sum_m x_1[m]\, g_1[n - 2^3 m] \\
& + \sum_m x_2[m]\, g_2[n - 2^2 m] \\
& + \sum_m x_3[m]\, g_3[n - 2 m]
\end{aligned}
$$

• Dyadic Discrete-Time Wavelets:

$$x[n] = \sum_{k=0}^{M-1} \sum_{m} x_k[m] \underbrace{g_k[n - 2^{n_k} m]}_{\text{wavelet basis}}$$

• wavelet coefficients:

$$x_k[n] = \sum_{m} x[m]\, h_k[2^{n_k} n - m]$$

• bi-orthogonality:

$$\sum_{n=-\infty}^{\infty} g_k[n - 2^{n_k} m]\, h_\ell[n - 2^{n_\ell} i] = \delta[k-\ell]\,\delta[m-i]$$

- See Fig. 11.3-3 on pg. 486 of V. Text
- See PRNonuniform.m at course web site
- Note: for $M=4$ (3 level binary tree)

$n_0 = 3$

$n_1 = 3$

$n_2 = 2$

$n_1 = 1$