DIP EE 4830 Sp'05
March 3rd. Lec #7.

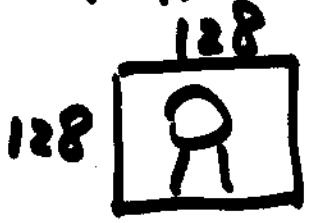
Midterm March 10th. 4:10-6 pm

Material Covered Lec #1 - #7.

Office Hours: Mon 2-3:30 pm
CEPSR Rm 709

HW#3 Due the same day.

P.1. Eigenface Problem



KLT transform
$\vec{u}$ input $N \times 1$ vector
$\vec{v}$ output

Sample Code Row-major scan

$$R_u(i,j) = \underline{Cov}(u(i), u(j)) = E((u_i - m)(u_j - m))$$

$\underline{R_u}$: size $16k \times 16k$

Eigenvectors of R_u : $16k$

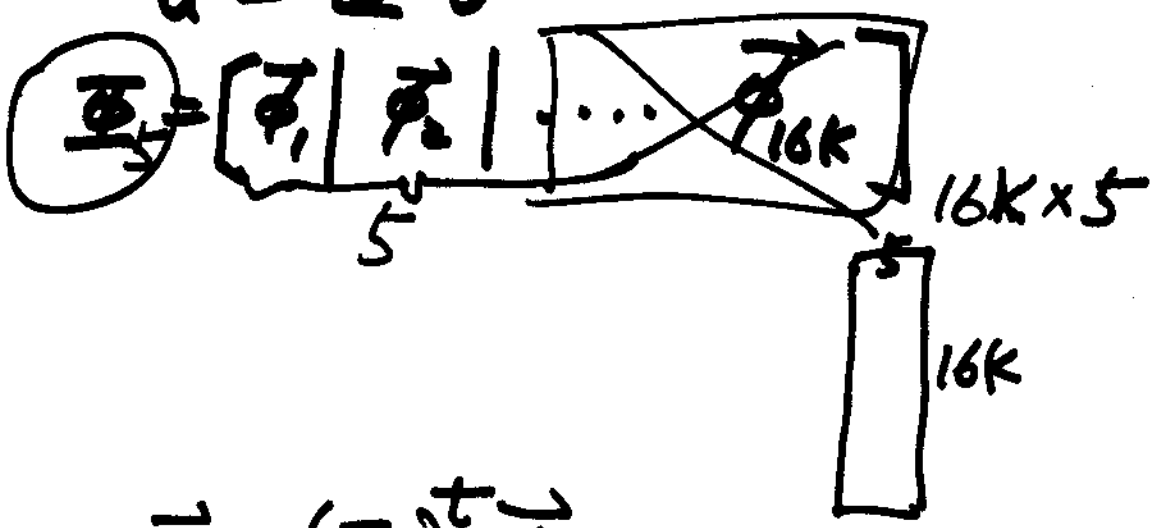
$\vec{\phi}_1, \vec{\phi}_2 \cdots \vec{\phi}_{16k}$

top: return the e.v. with the largest $\#\lambda$: 32

$\vec{\phi}_1\ \vec{\phi}_2 \cdots \vec{\phi}_{16k}$ $16k \times 1$

KLT: $\vec{v} = \Phi^t \vec{u}$

$\vec{u} = \Phi \vec{v}$

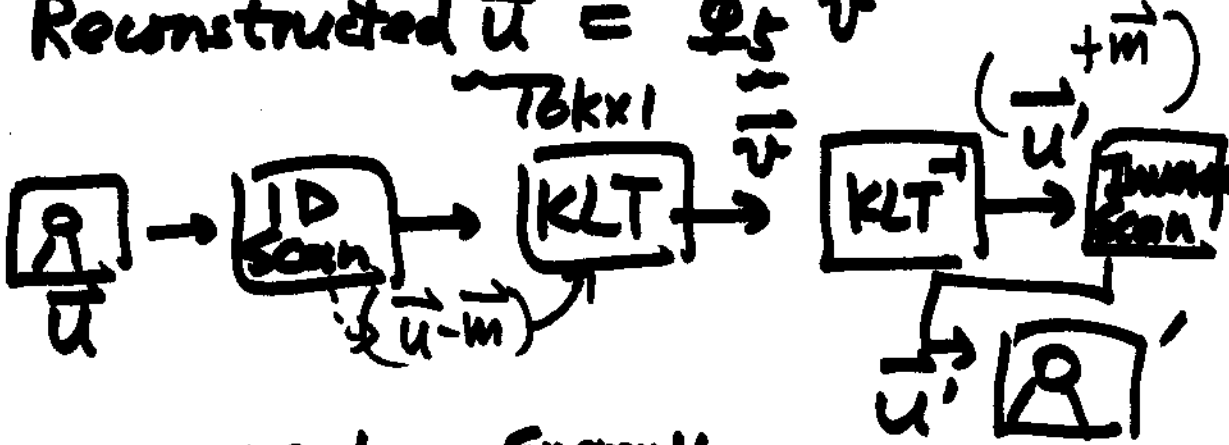


$\underset{5\times 1}{\vec{v}} = (\Phi_5)^t \underset{16k\times 1}{\vec{u}}$

↳ KLT transform coeff.

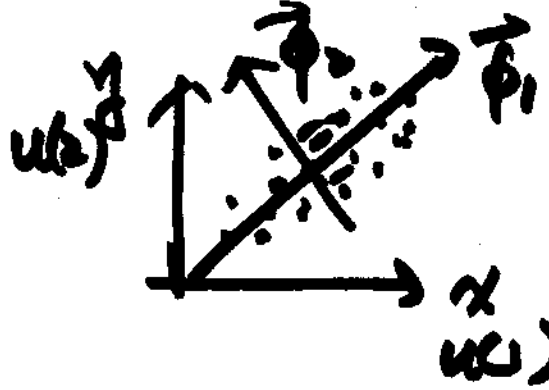
Good Example of Compression

Reconstructed $\vec{u}' = \Phi_5 \vec{v}$



SNR: $10 \cdot \log_{10} \frac{\text{Energy } u}{\text{Energy Err}}$ (dB)

$\vec{e} = \vec{u} - \vec{u}'$, Energy $= \sum_x |e(x)|^2$



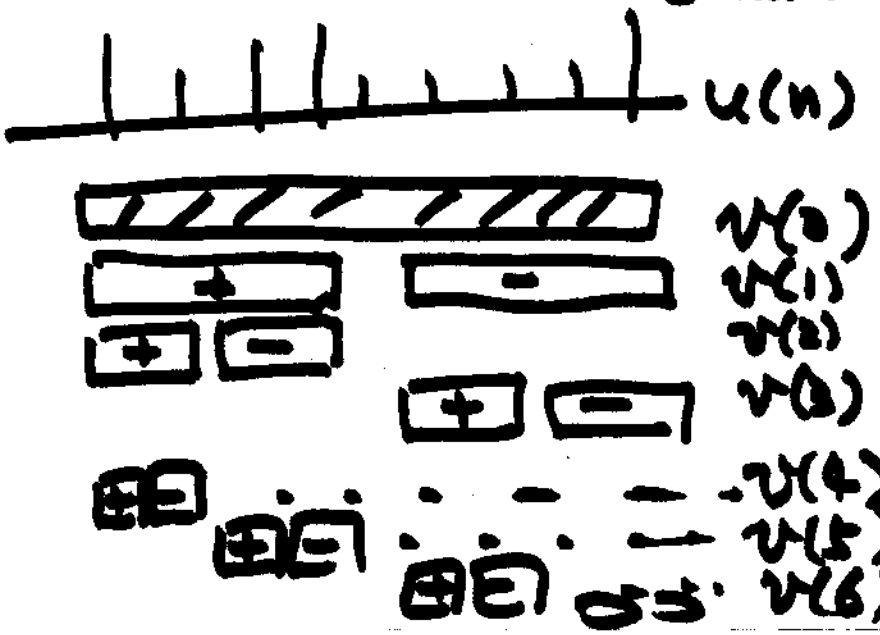
Fourier Transform $e^{j\omega k}$) Sinusoidal.
Dis. Cosine Transform Cos.( )
Harr. Transform Square. signal
8-pt Transform

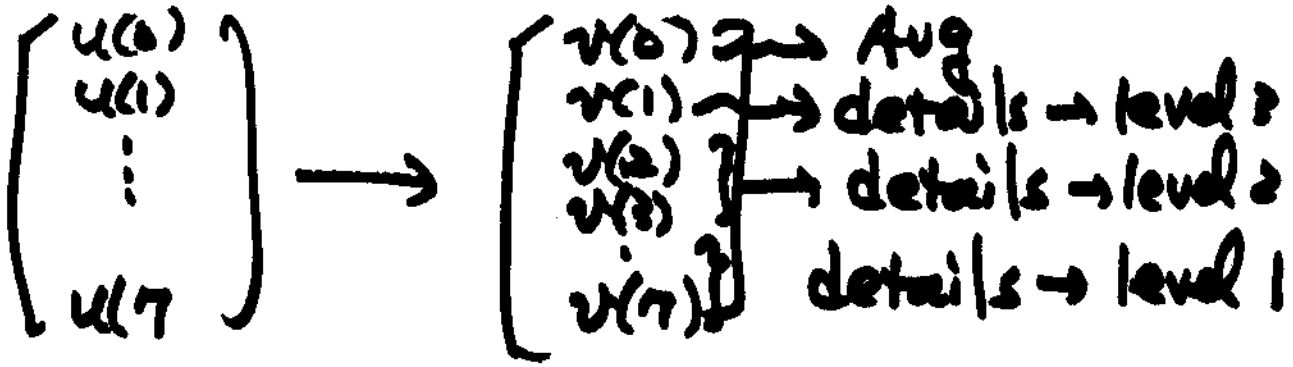
$$\begin{bmatrix} v(0) \\ v(1) \\ \vdots \\ v(7) \end{bmatrix} = \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ \sqrt{2} & \sqrt{2} & -\sqrt{2} & -\sqrt{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \sqrt{2} & \sqrt{2} & -\sqrt{2} & -\sqrt{2} \\ 2 & -2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & -2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & -2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 2 & -2 \\ 1 & -1 & -1 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}_{8\times 8} \begin{bmatrix} u(0) \\ u(1) \\ u(2) \\ \vdots \\ u(7) \end{bmatrix}$$

dc
diff

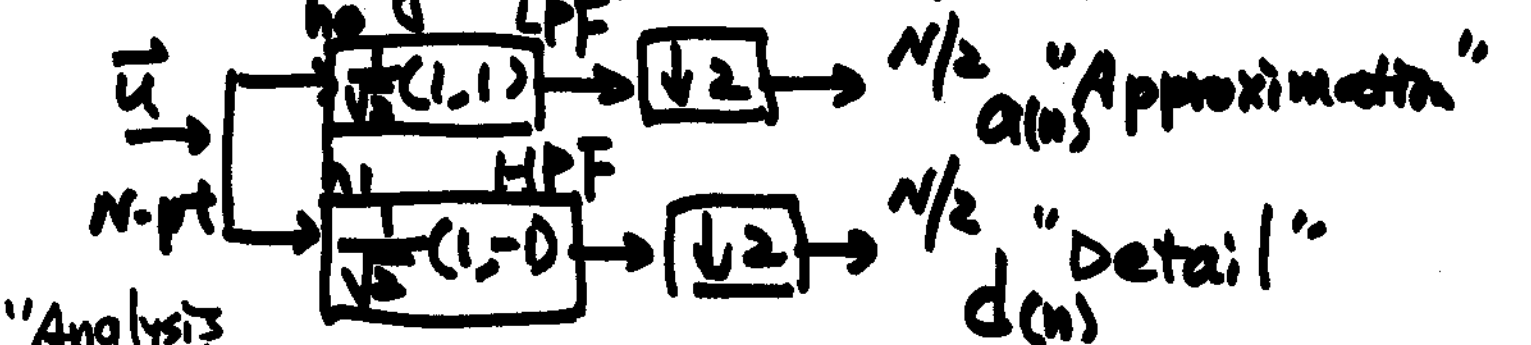
$$\vec{v}_{8\times 1} = [\,\cdot\,]_{8\times 8} \cdot \vec{u}_{8\times 1}$$

8 numbers





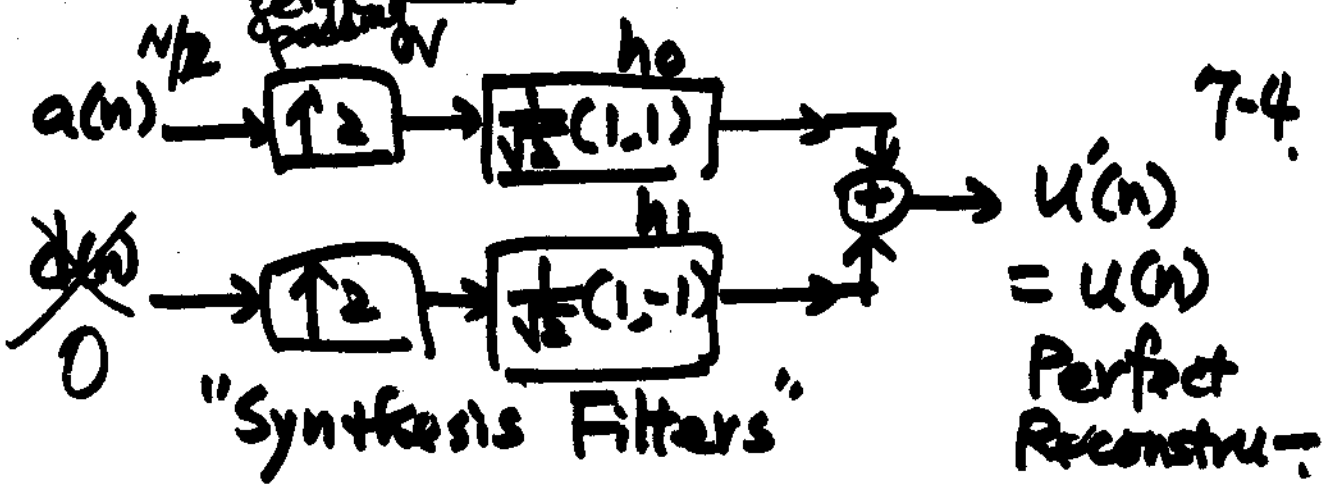
Building Block : 2x2 Filter Bank

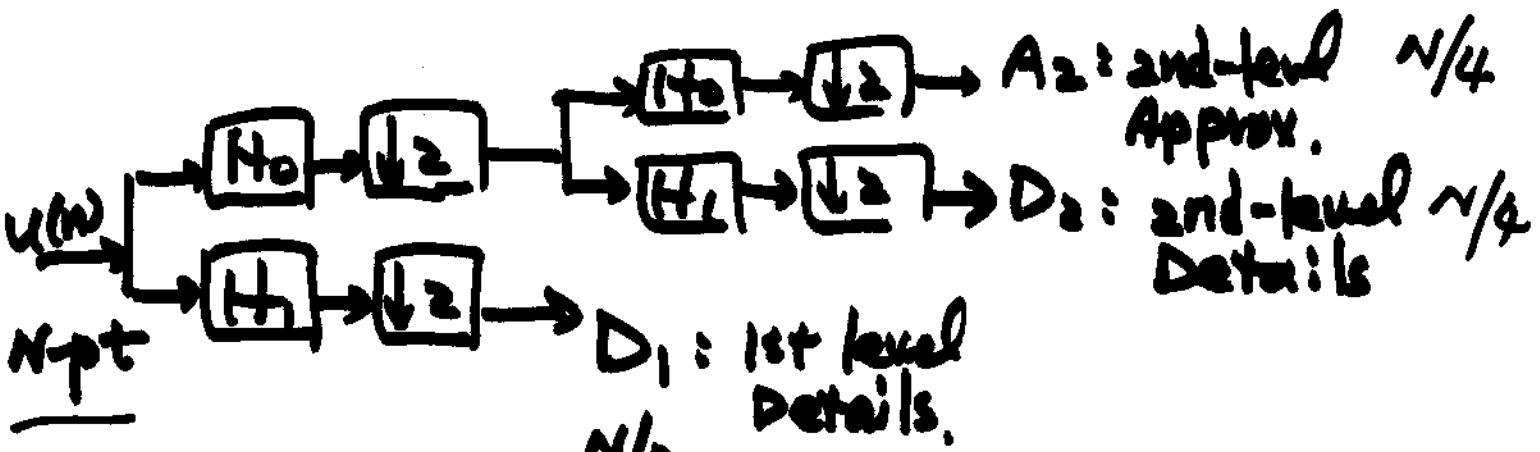


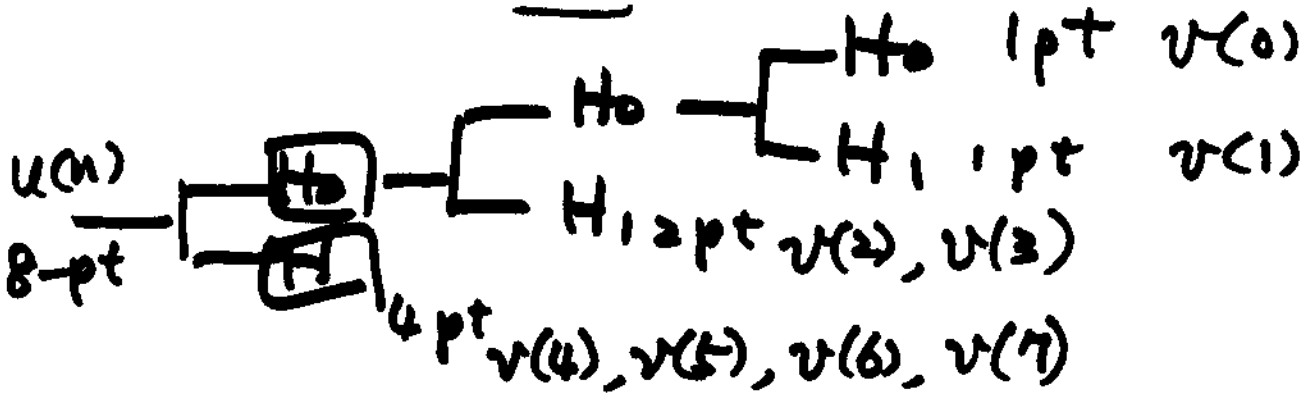
$$v(n) = u(n) \circledast h(n)$$

"Convolution"

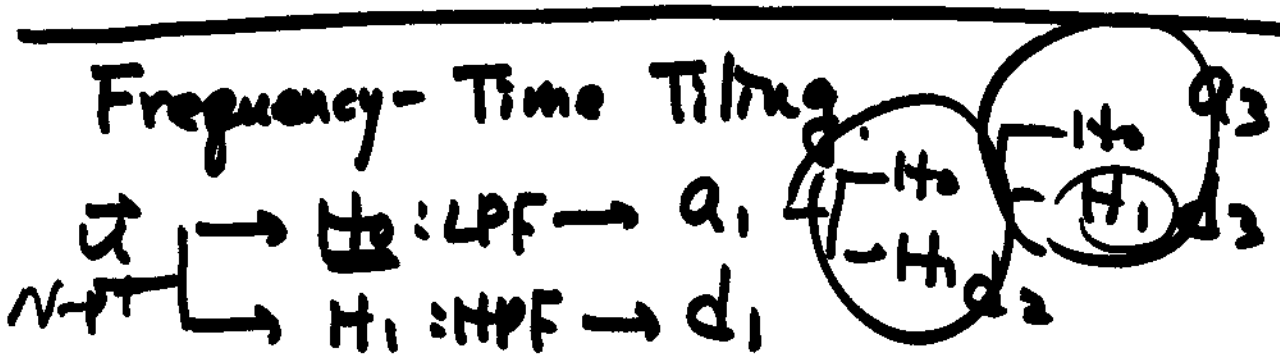
$$= \sum_{m=-\infty}^{\infty} u(m)\, h(n-m)$$

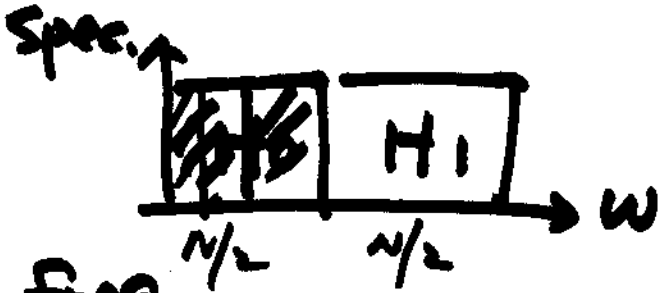


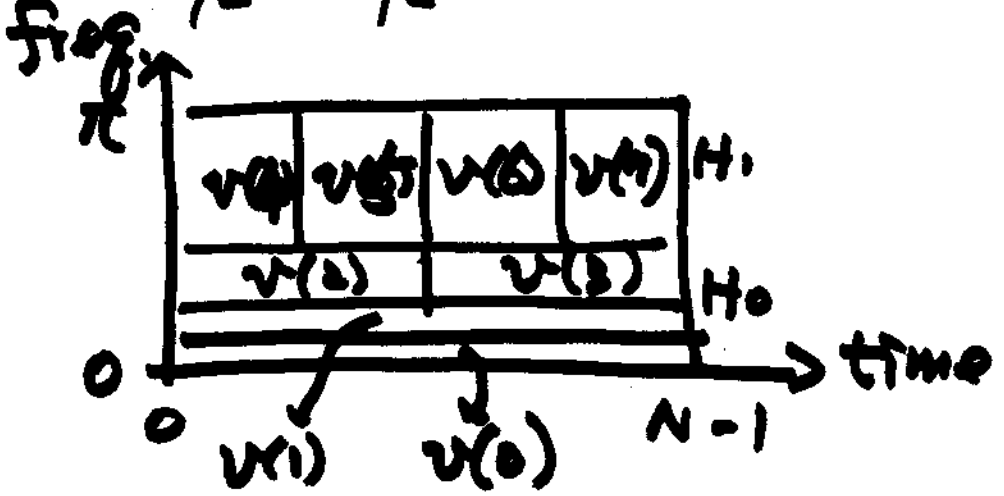




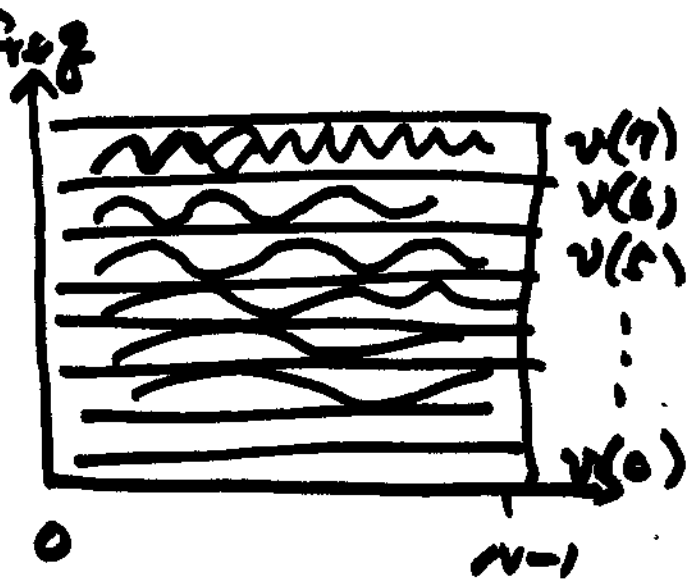
Frequency-Time Tiling



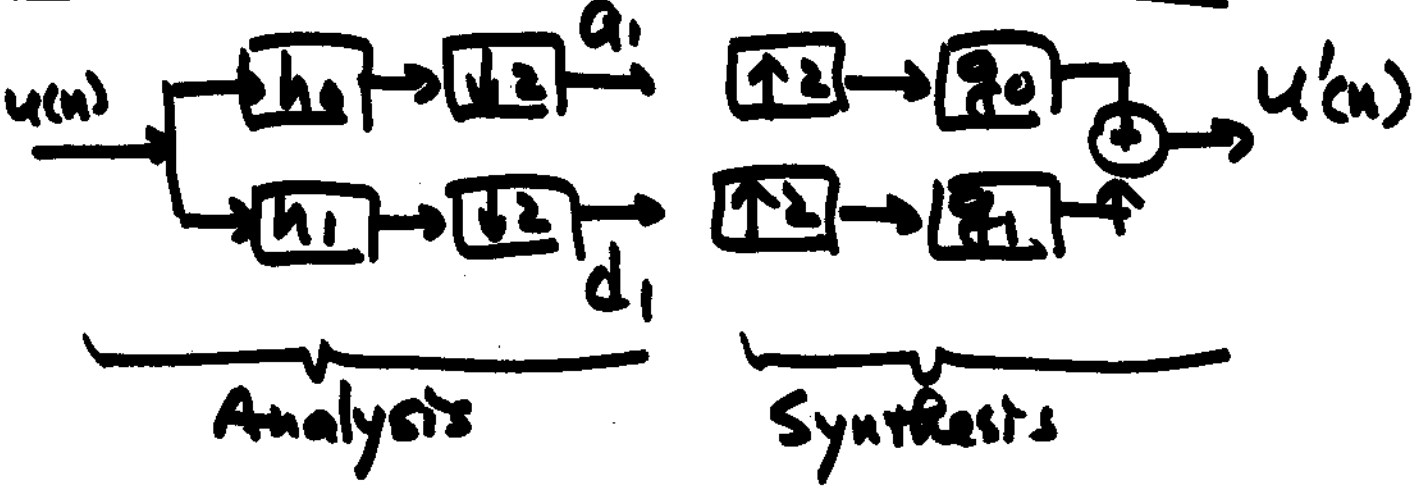




FT



$$v(k) = e^{-j\frac{2\pi}{N}k \cdot n} \otimes u(n)$$



How to design h_0, h_1, g_0, g_1

s.t. $u'(n) = u^*(n)$ P.R.

Wavelet, subband.

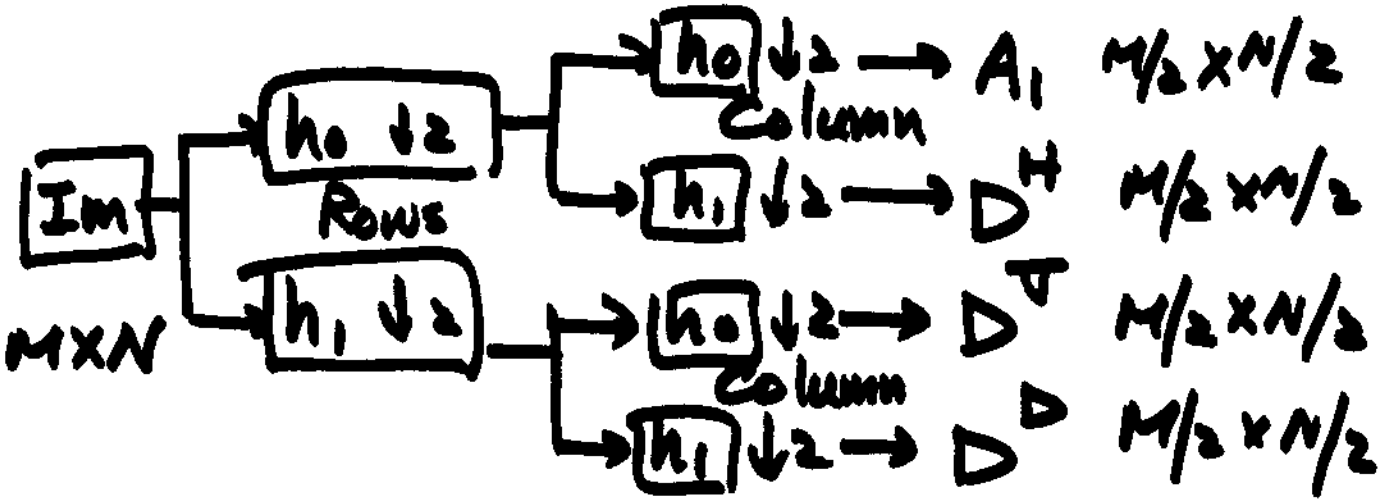
ADSP 6860

P.R. Condition

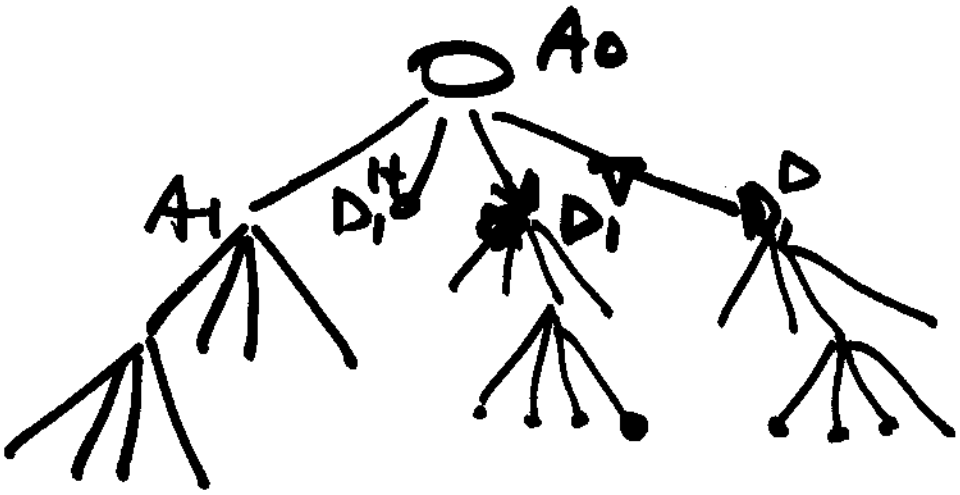
$$\begin{cases} H_0(z)G_0(z) + H_1(z)G_1(z) = 2 \\ H_0(-z)G_0(z) + H_1(-z)G_1(z) = 0 \end{cases}$$

z-transform DSP

Harr Filter is the simplest form of WT.



Wavelet Packet



Information measure at each node.

Image Texture Analysis