ECE 468: Digital Image Processing

Lecture 10

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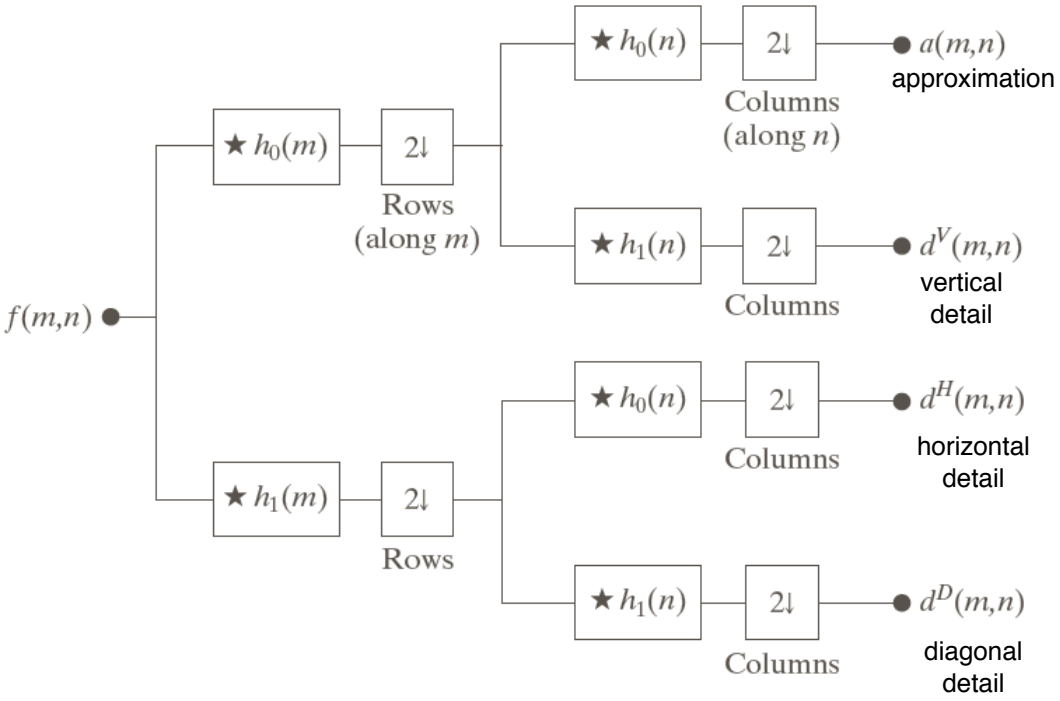
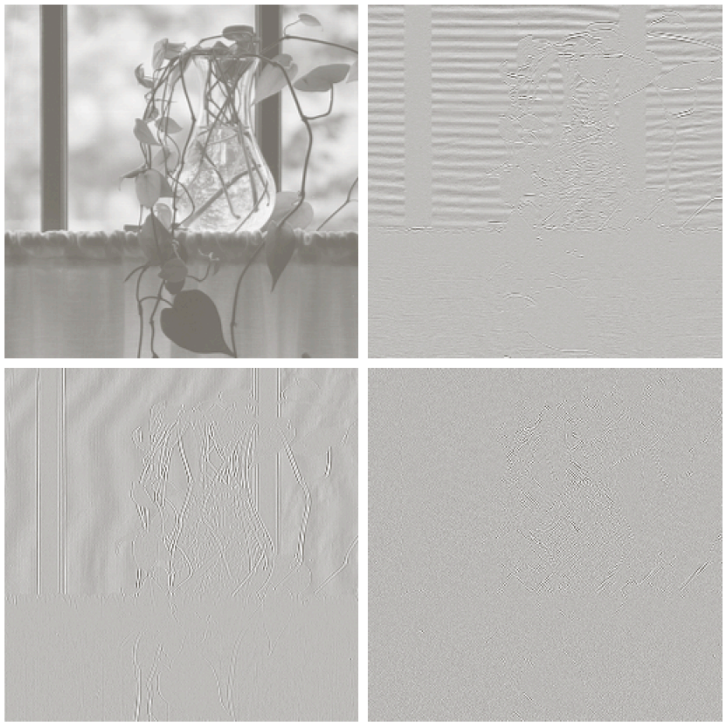
2D Subband Coding using 1D Orthonormal Filters



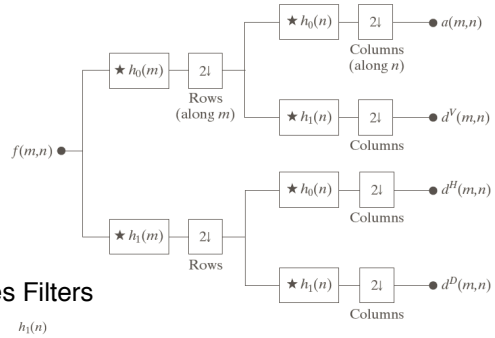
Example: 2D Subband Coding



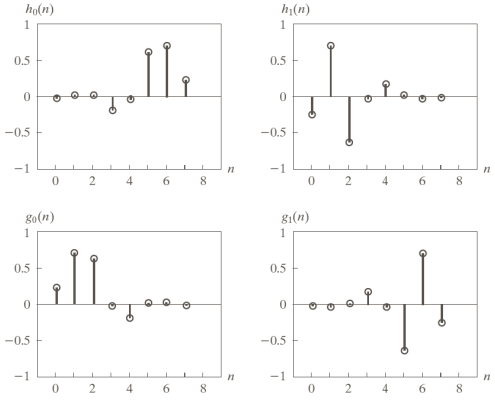
a b
c d

FIGURE 7.9
A four-band split of the vase in Fig. 7.1 using the subband coding system of Fig. 7.7. The four subbands that result are the (a) approximation, (b) horizontal detail, (c) vertical detail, and (d) diagonal detail subbands.

2D Subband Coding using 1D Orthonormal Filters



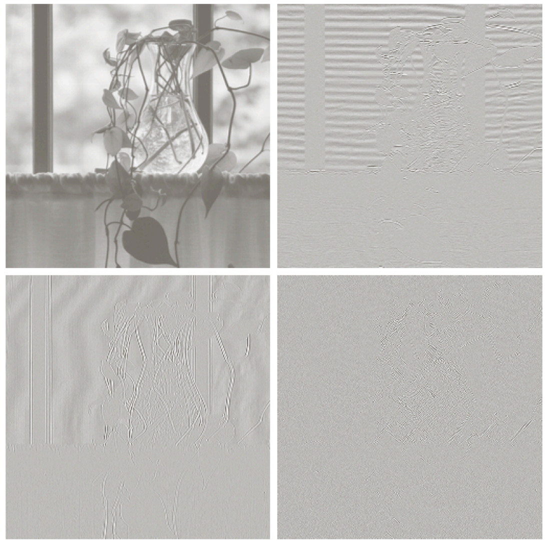
Daubechies Filters



$$g_1(n) = (-1)^n g_0(K_{\text{even}} - 1 - n)$$

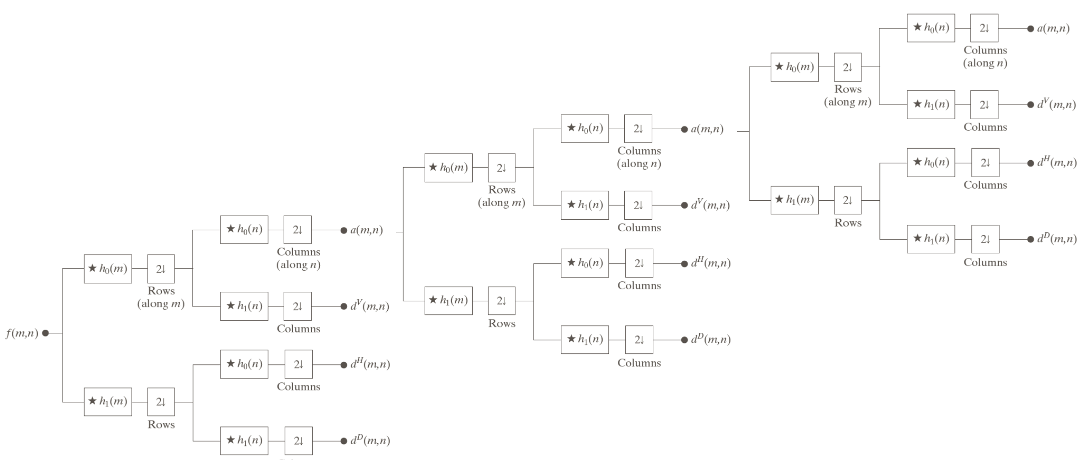
$$h_i(n) = g_i(K_{\text{even}} - 1 - n), \quad i = \{0, 1\}$$

Example: 2D Subband Coding

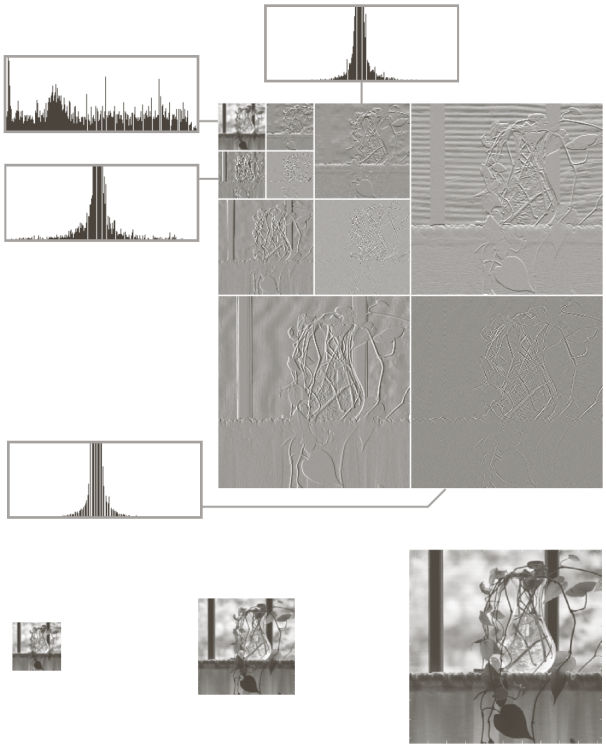


Prominent aliasing

Multiresolution Subband Coding

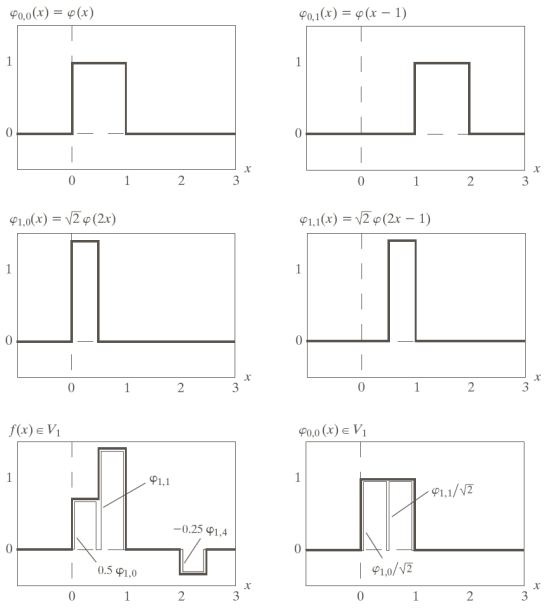


Example: Multiresolution Subband Coding



Multiresolution Expansions

Example: Haar Scaling Functions



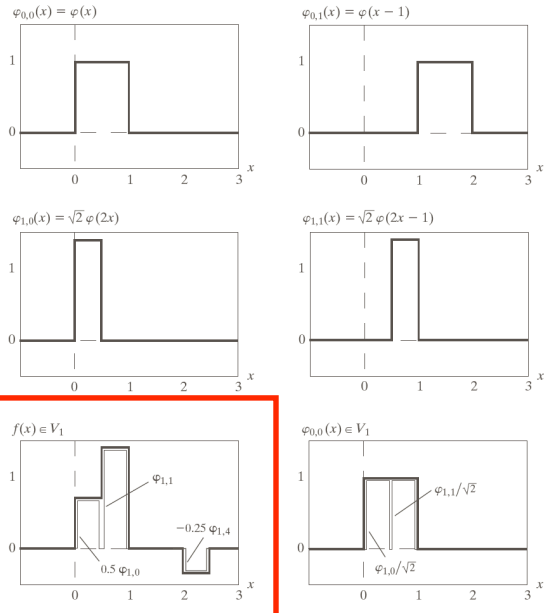
a b
c d
e f

FIGURE 7.11 Some Haar scaling functions.

$$f(x) = 0.5\varphi_{1,0}(x) + \varphi_{1,1}(x) - 0.25\varphi_{1,4}(x)$$

$$\varphi_{0,k}(x) = \frac{1}{\sqrt{2}}\varphi_{1,2k}(x) + \frac{1}{\sqrt{2}}\varphi_{1,2k+1}(x)$$

Example: Haar Scaling Functions



Function in V_1

a b
c d
e f

FIGURE 7.11 Some Haar scaling functions.

$$f(x) = 0.5\varphi_{1,0}(x) + \varphi_{1,1}(x) - 0.25\varphi_{1,4}(x)$$

$$\varphi_{0,k}(x) = \frac{1}{\sqrt{2}}\varphi_{1,2k}(x) + \frac{1}{\sqrt{2}}\varphi_{1,2k+1}(x)$$

Nested Function Spaces

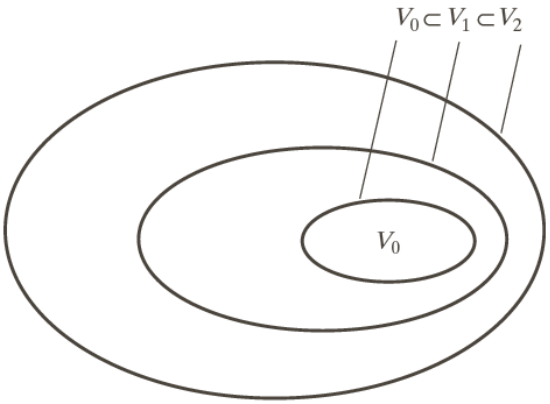


FIGURE 7.12
The nested function spaces spanned by a scaling function.