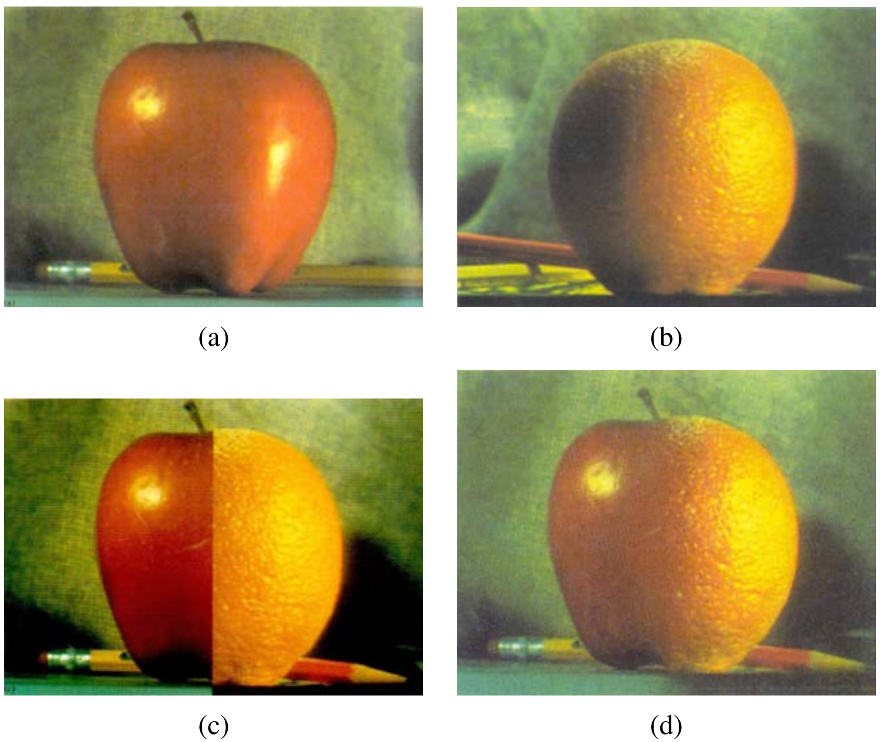
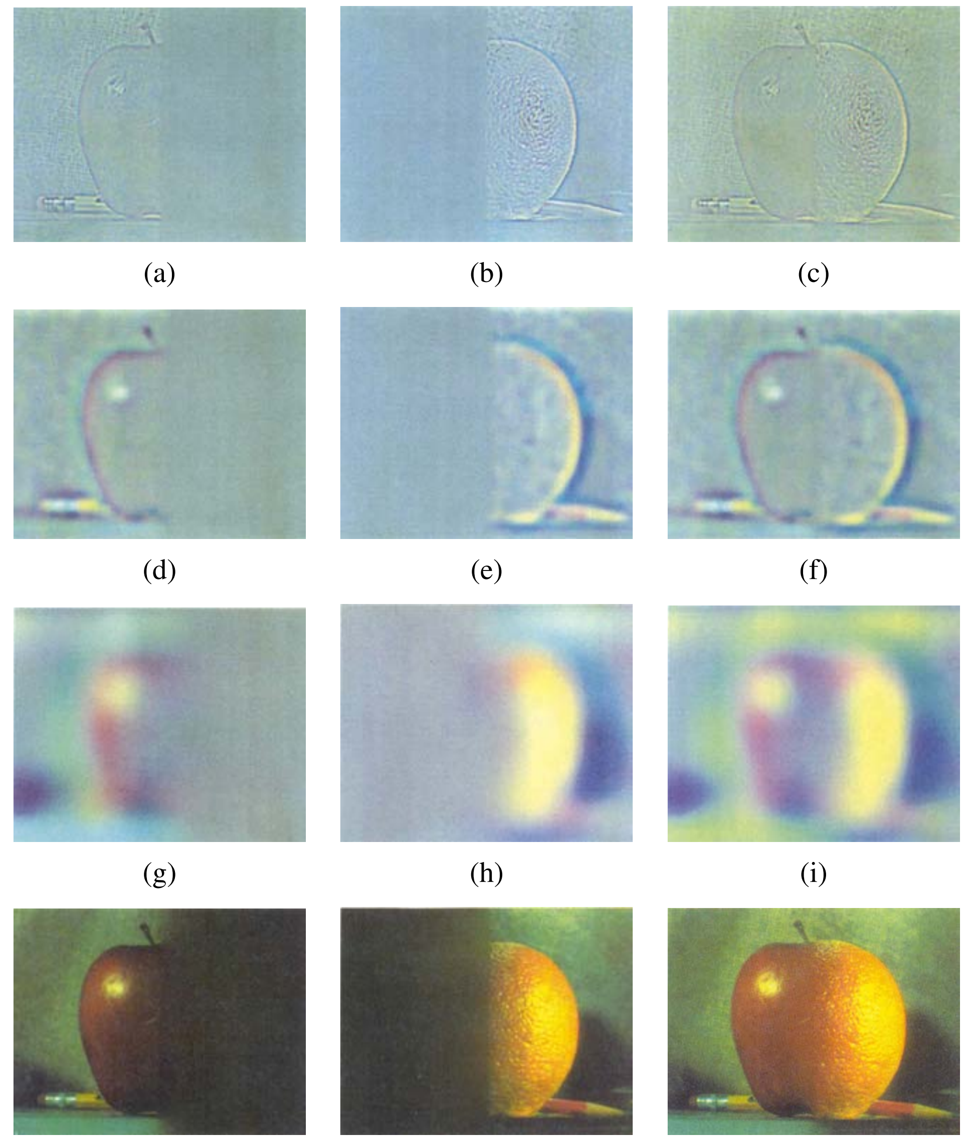
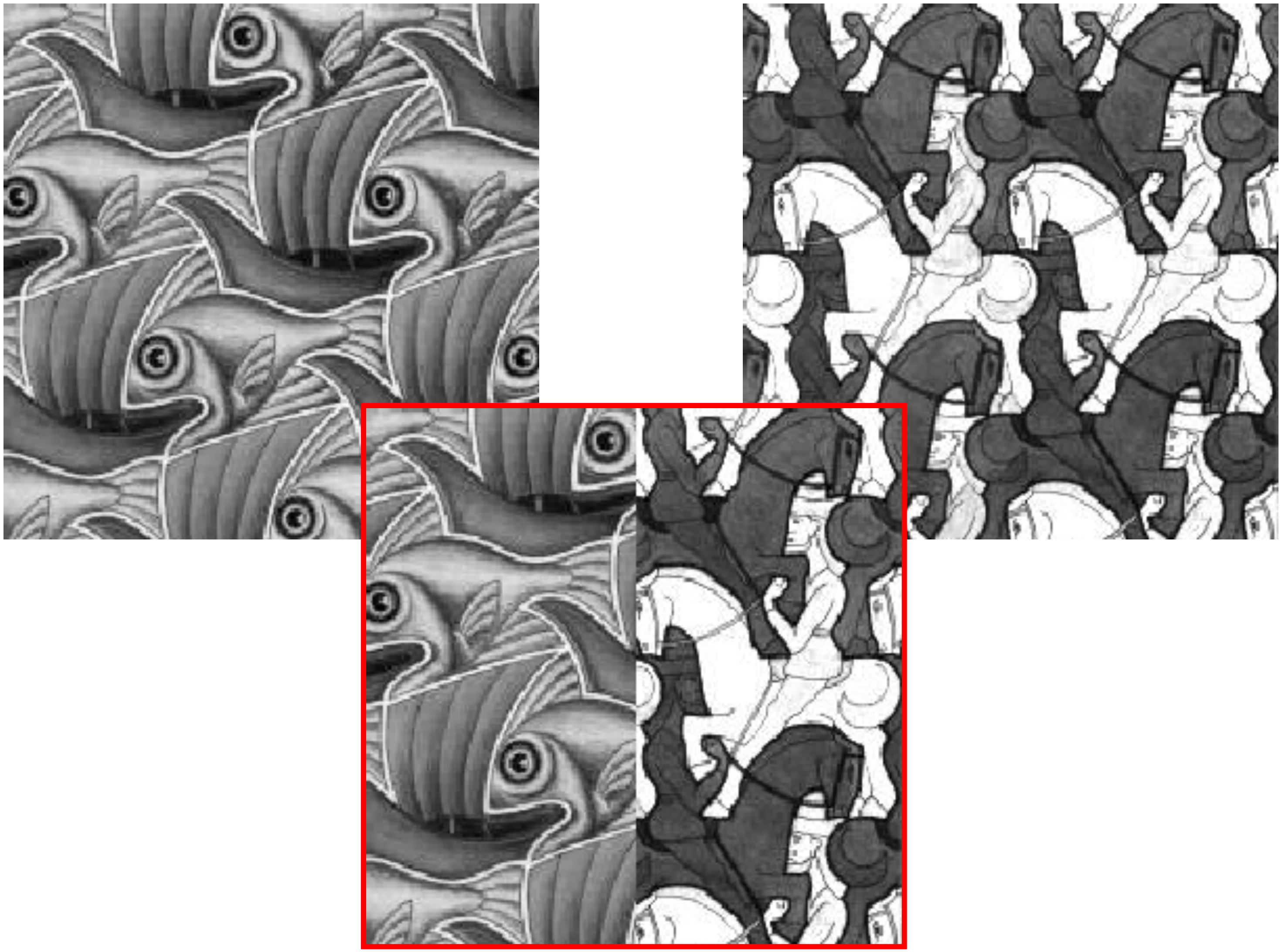
Application: Image Blending



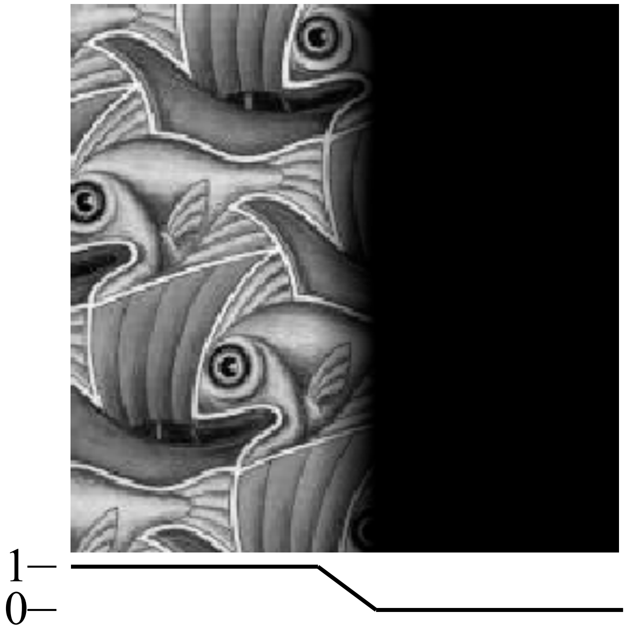


Laplacian pyramid blending (Burt and Adelson 1983b)

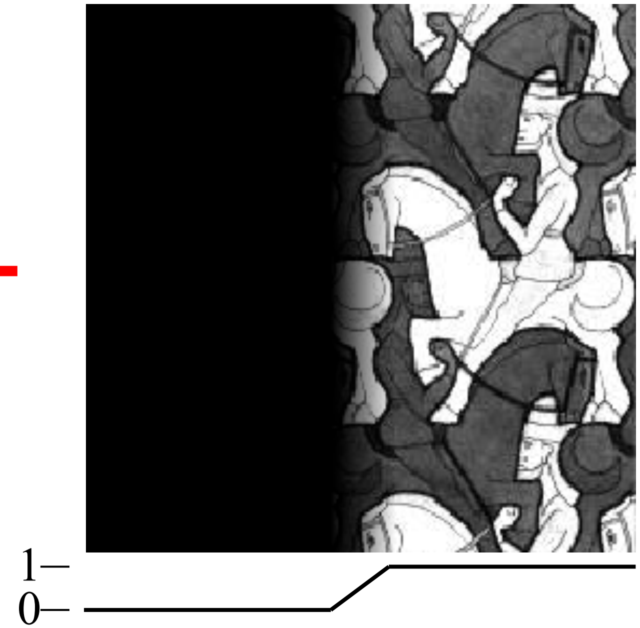
Blending



Alpha Blending / Feathering



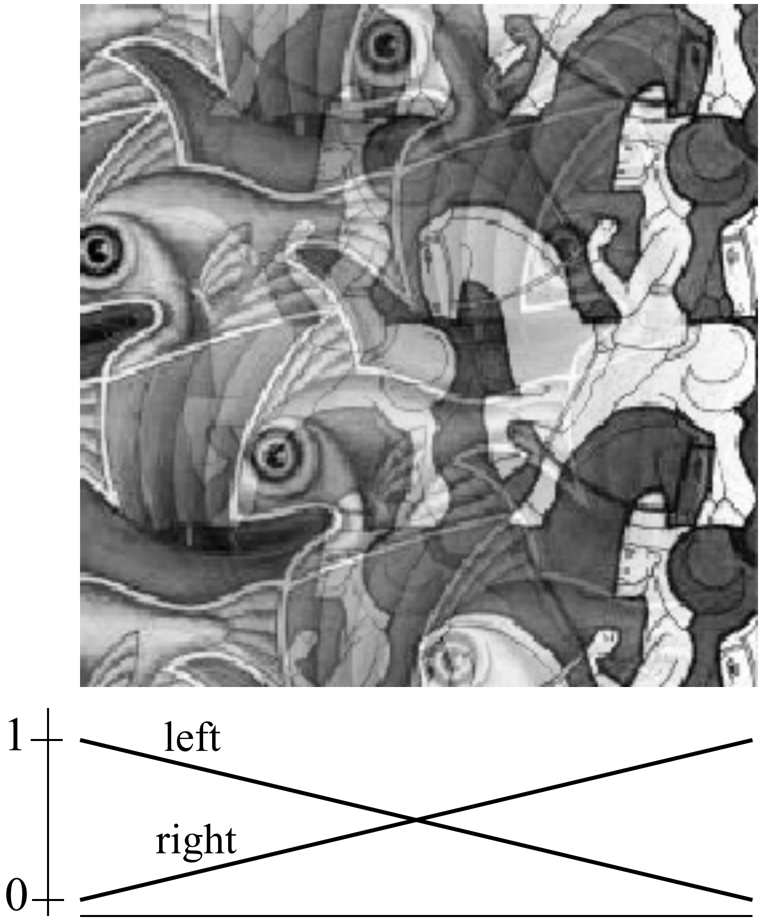
+

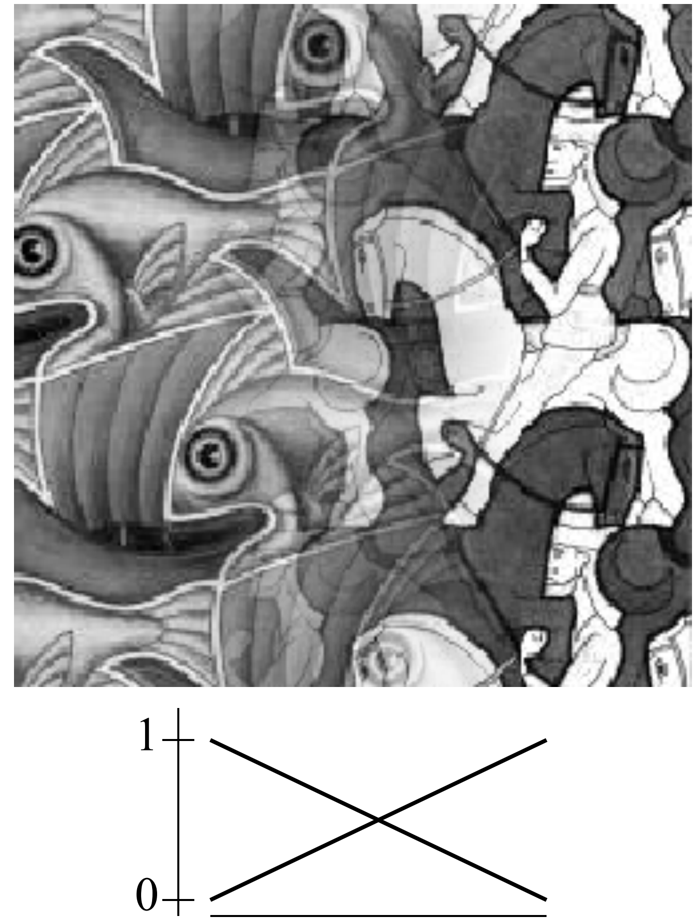


=

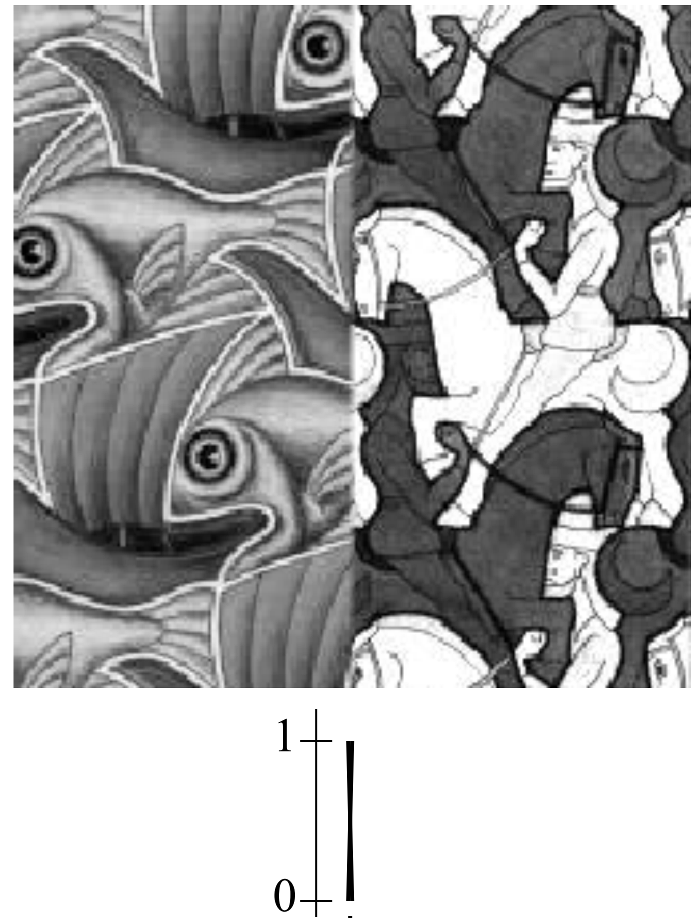
$$I_{blend} = \alpha I_{left} + (1\text{-}\alpha) I_{right}$$

Affect of Window Size

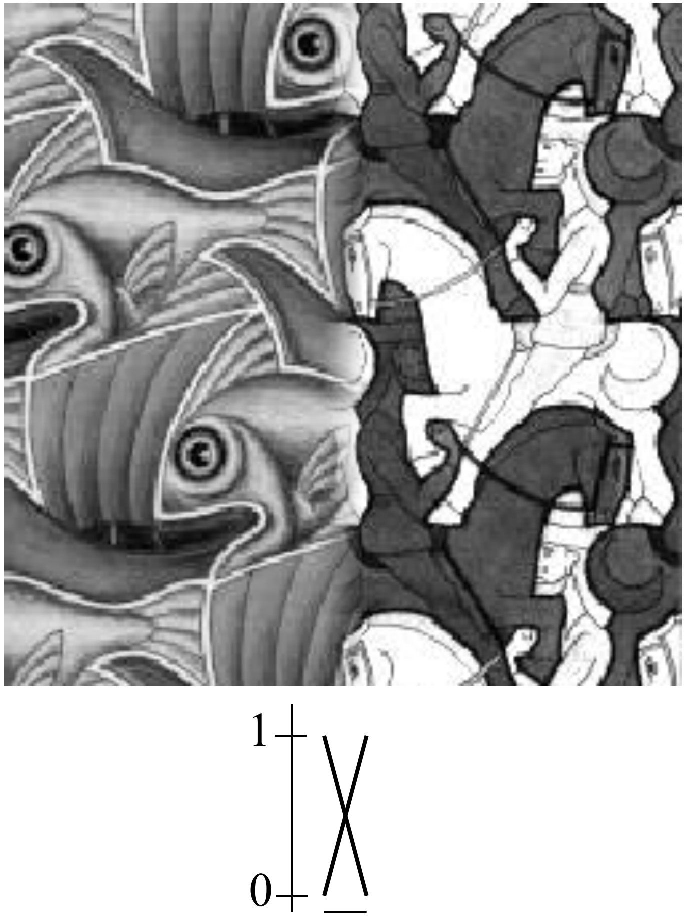




Affect of Window Size



Good Window Size



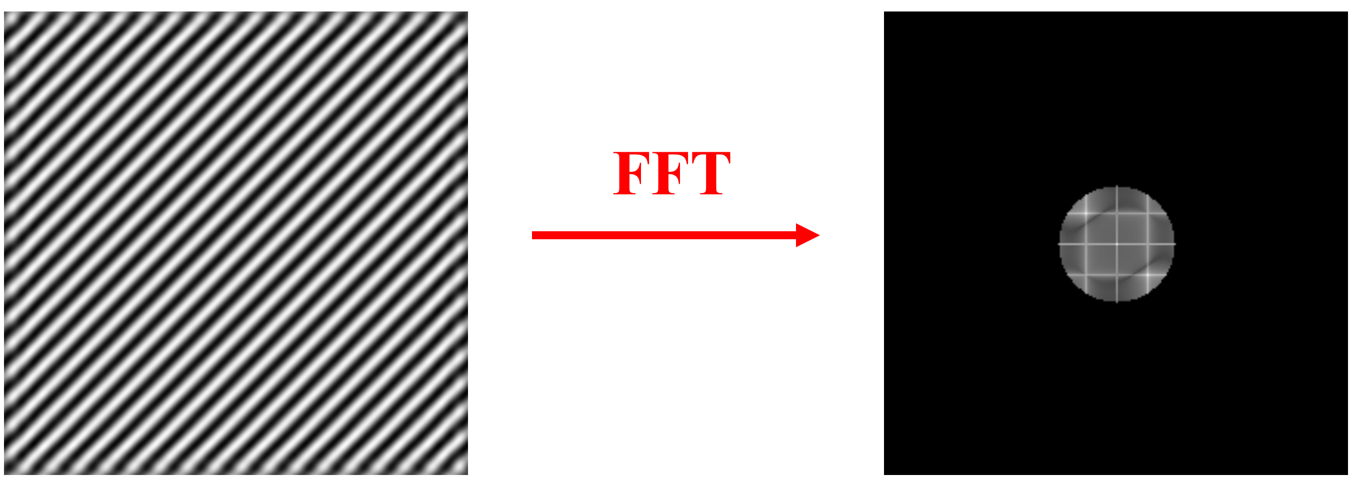
"Optimal" Window: smooth but not ghosted

What is the Optimal Window?

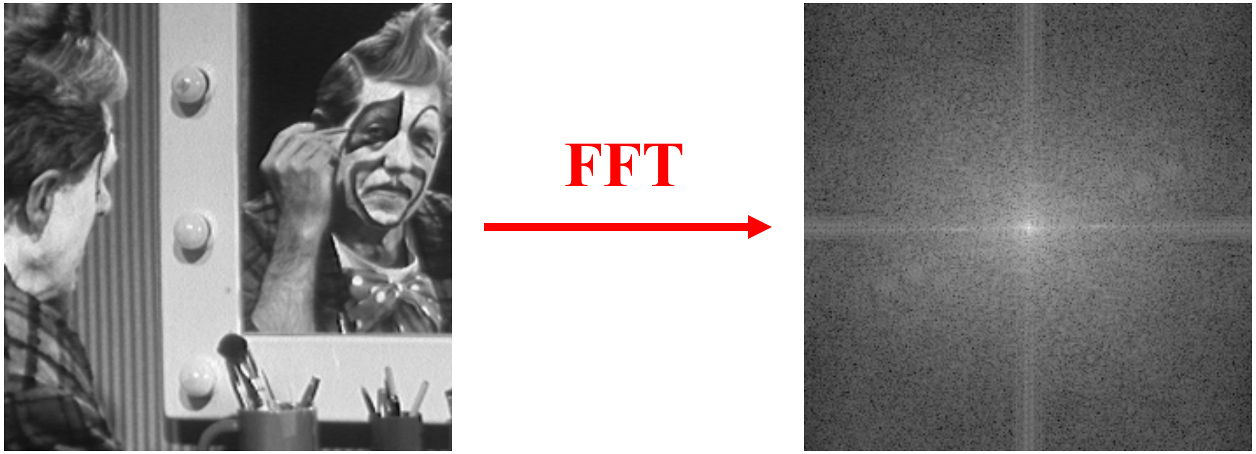
- To avoid seams
  - window = size of largest prominent feature
- To avoid ghosting
  - window <= 2*size of smallest prominent feature

Natural to cast this in the *Fourier domain*

- largest frequency <= 2*size of smallest frequency
- image frequency content should occupy one “octave” (power of two)



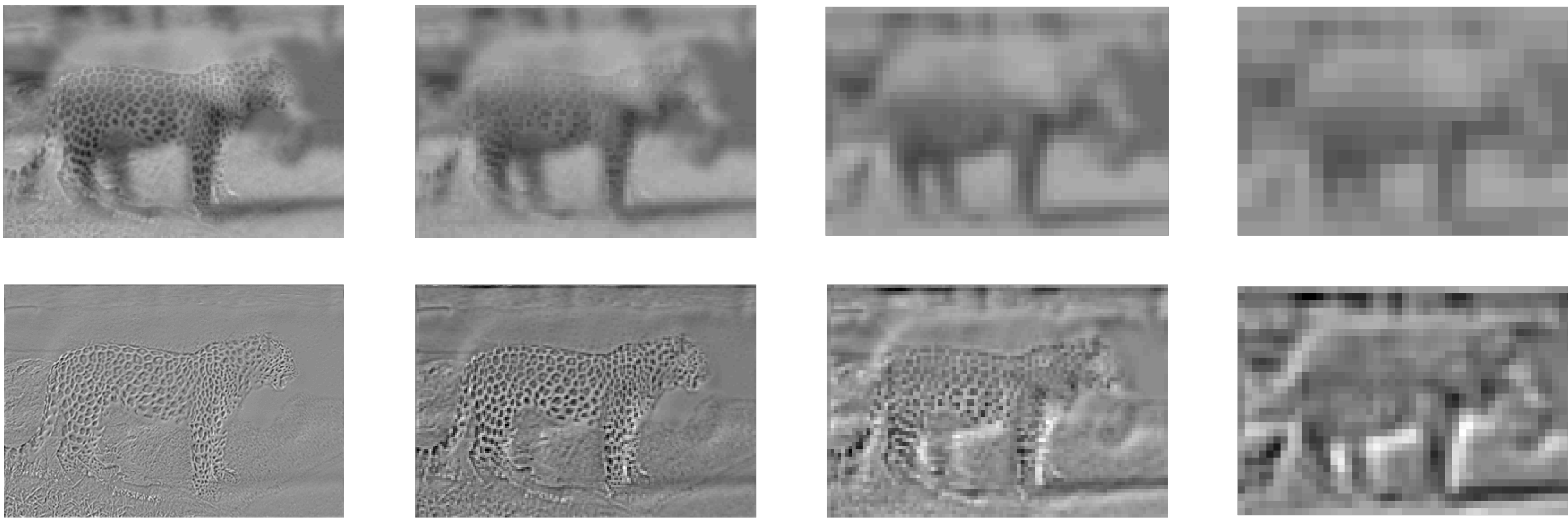
What if the Frequency Spread is Wide



- Idea (Burt and Adelson)
  - Compute $F_{left} = FFT(I_{left})$, $F_{right} = FFT(I_{right})$
  - Decompose Fourier image into octaves (bands)
    - $F_{left} = F_{left}^1 + F_{left}^2 + \ldots$
  - Feather corresponding octaves F_{left}^i with F_{right}^i
    - Can compute inverse FFT and feather in spatial domain
  - Sum feathered octave images in frequency domain
- Better implemented in *spatial domain*

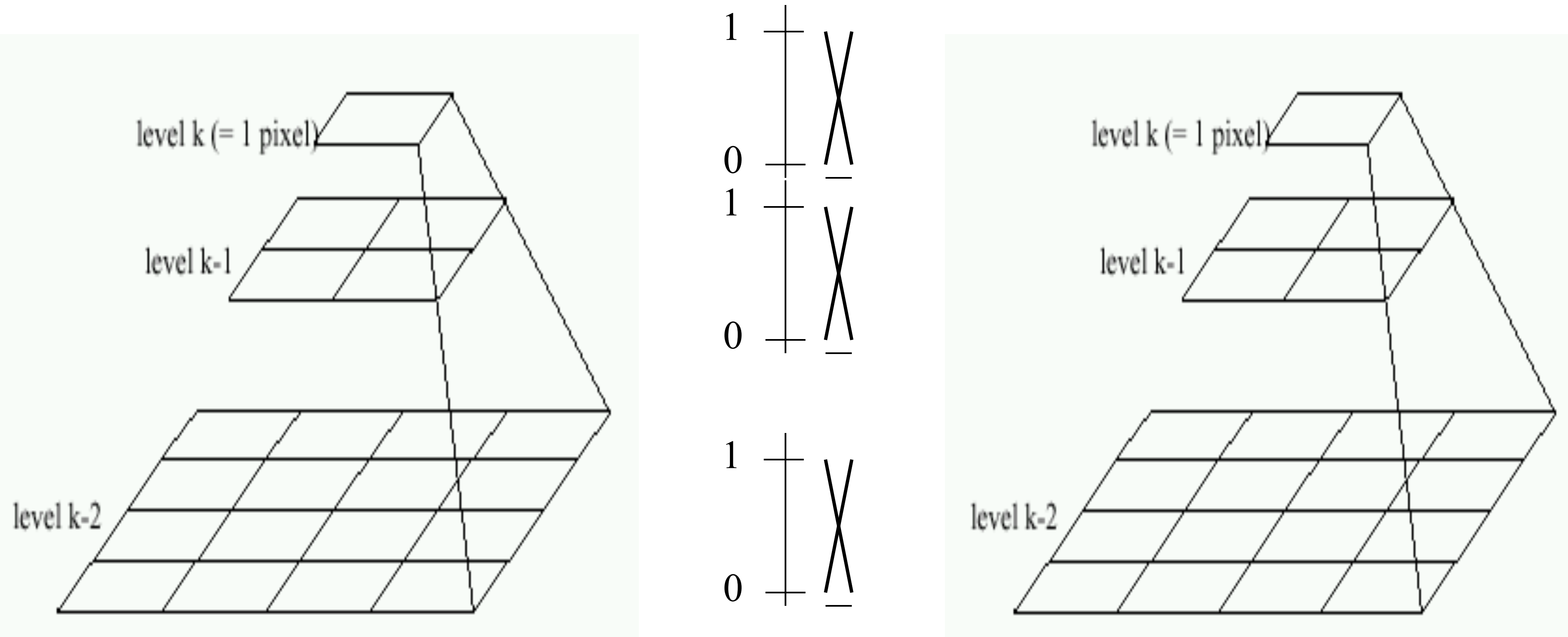
Octaves in the Spatial Domain

Lowpass Images



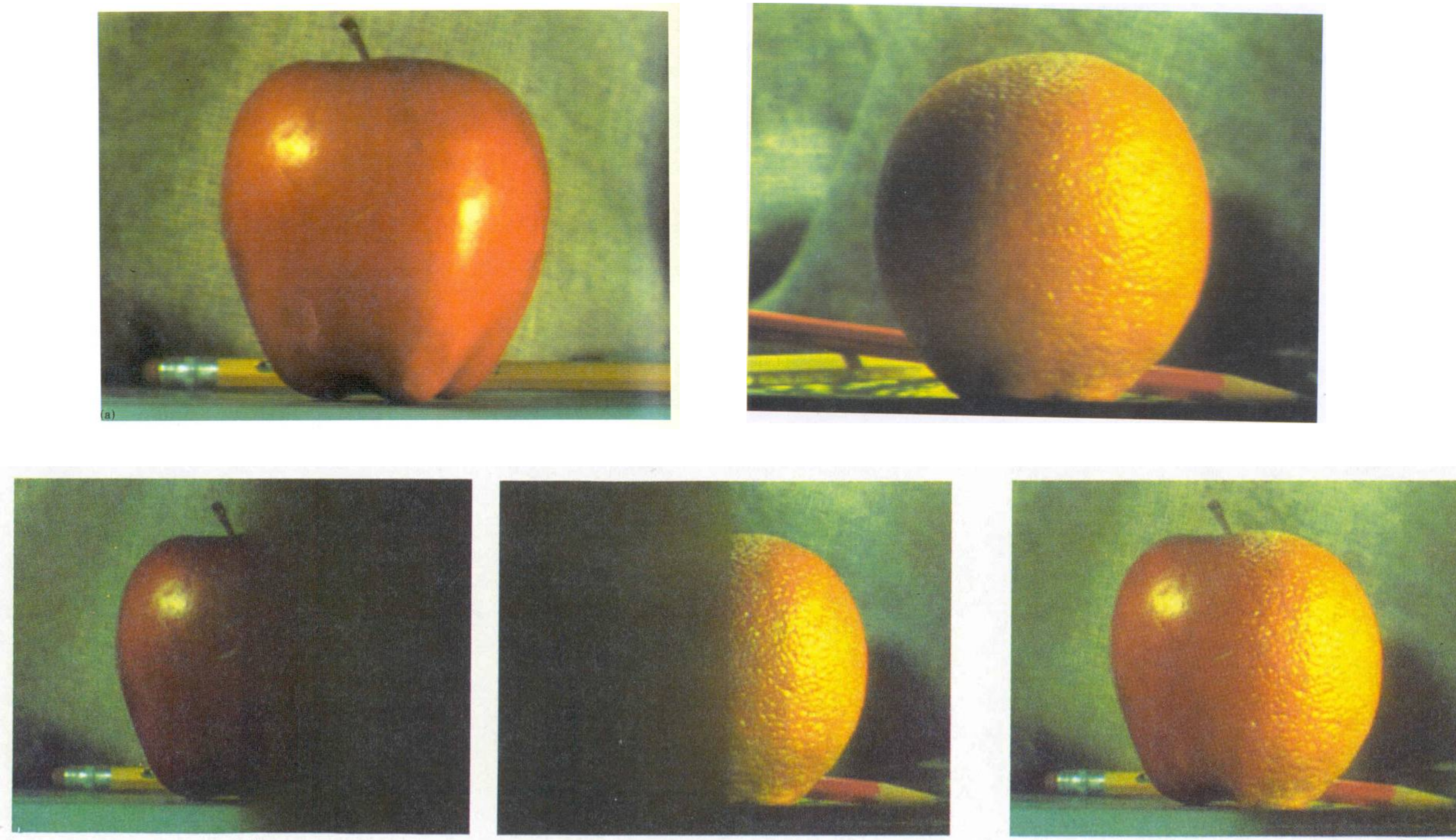
- Bandpass Images

Pyramid Blending

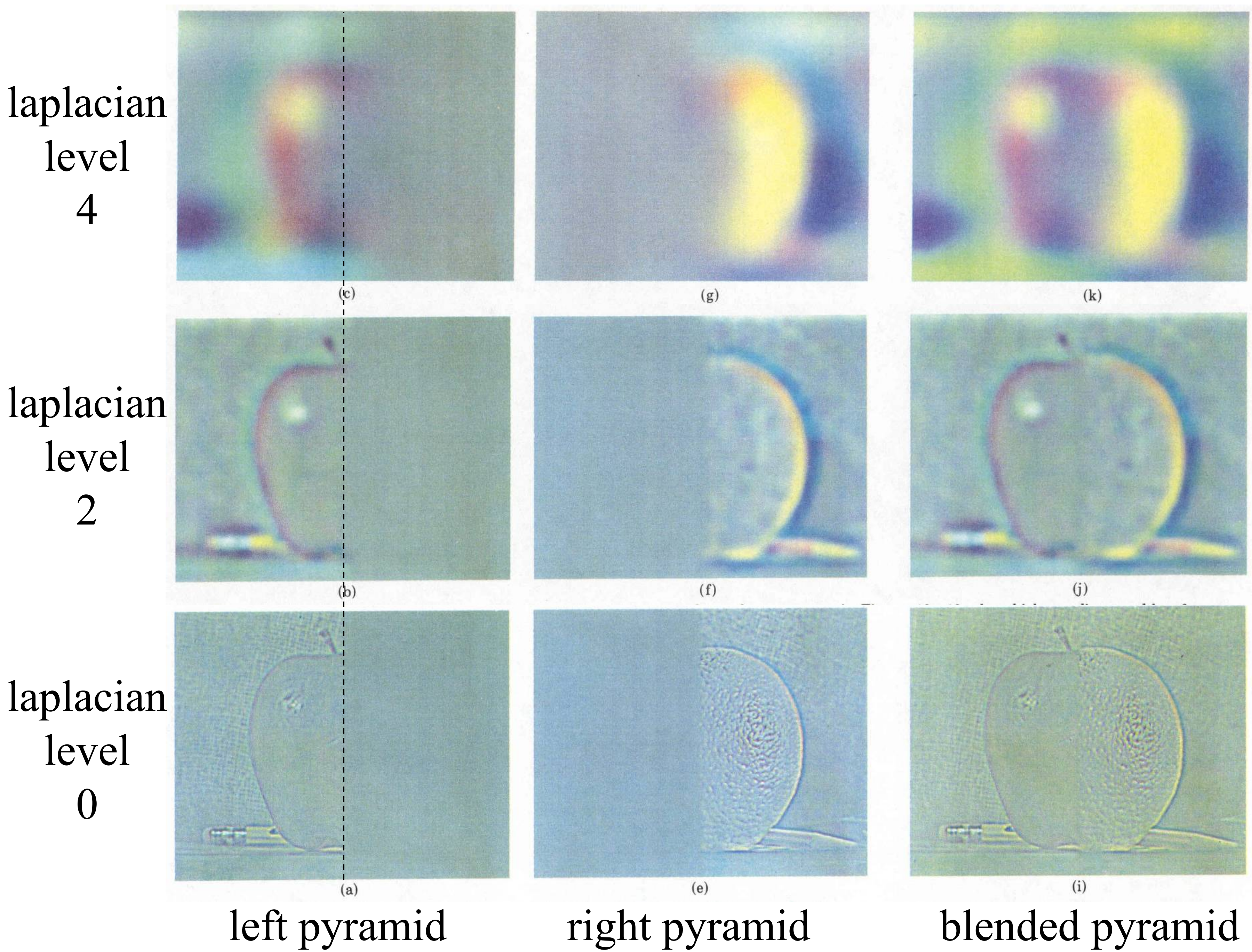


Left pyramid blend Right pyramid

Pyramid Blending



(d) (h) (l)


laplacian level 4
laplacian level 2
laplacian level 0
(c)
(g)
(k)
(b)
(f)
(j)
(a)
(e)
(i)
left pyramid
right pyramid
blended pyramid

Blending Regions

Laplacian Pyramid: Blending

- General Approach:
  1. Build Laplacian pyramids *LA* and *LB* from images *A* and *B*
  2. Build a Gaussian pyramid *GR* from selected region *R*
  3. Form a combined pyramid *LS* from *LA* and *LB* using nodes of *GR* as weights:
     - *LS(i,j) = GR(I,j,)*LA(I,j) + (1-GR(I,j))*LB(I,j)*
  4. Collapse the *LS* pyramid to get the final blended image