Outline

- Multiresolution image processing (Textbook 7.1)
- Image Pyramids (Textbook 7.1.1)
Multiresolution Image Processing

• Informal motivation:
  • Images may show both very large and very small objects.
  • It may be useful to process the images at different resolutions.
Multiresolution Image Processing

- A more formal motivation:
- An image is a 2D random process with locally varying statistics of pixel intensities
- Analysis of statistical properties of pixel neighborhoods of varying sizes may be useful
Histogram of Small Pixel Neighborhoods
**Image Pyramids**

- A representation of the image that allows its multiresolution analysis
Example: Image Pyramids

**FIGURE 7.3**
Two image pyramids and their histograms:
(a) an approximation pyramid;
(b) a prediction residual pyramid.
Steps to Construct the Image Pyramid

1. Given an image at level j

2. Filter the input and and downsample the filtered result by a factor of 2; This gives the image at level j-1

3. Goto 1

4. Upsample and filter the image at level j-1; this gives an approximation of the image at level j

5. Subtract this result from the image at level j; this give the prediction residual at level j

6. Goto 1
Typical Filters

• For the multiresolution pyramid, we use spatial filters:
  • Neighborhood averaging
  • Lowpass Gaussian filter

• For the residual pyramid, we use interpolation filters:
  • bilinear
  • bicubic
Upsampling/Downsampling

- Upsampling = Inserting zeros

\[ f_{2 \uparrow}(x, y) = \begin{cases} 
  f(x/2, y/2) & , \quad x, y \text{ are even} \\
  0 & , \quad \text{o.w.}
\end{cases} \]

- Downsampling = Discarding pixels

\[ f_{2 \downarrow}(x, y) = f(2x, 2y) \]
Next Class

- Haar Transform (Textbook 7.1.3)