COL783: Digital Image Processing

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Image Restoration

Image Enhancement vs Image Restoration

Image enhancement: “improve” an image subjectively.
Image restoration: remove distortion from image in order to go back to the “original” objective process

Original image

Blurred image

(Source: Gonzalez and Woods)

Image Restoration

- Use a priori knowledge of the degradation
- Modeling the degradation and apply the inverse process
- Formulate and evaluate objective criteria of goodness

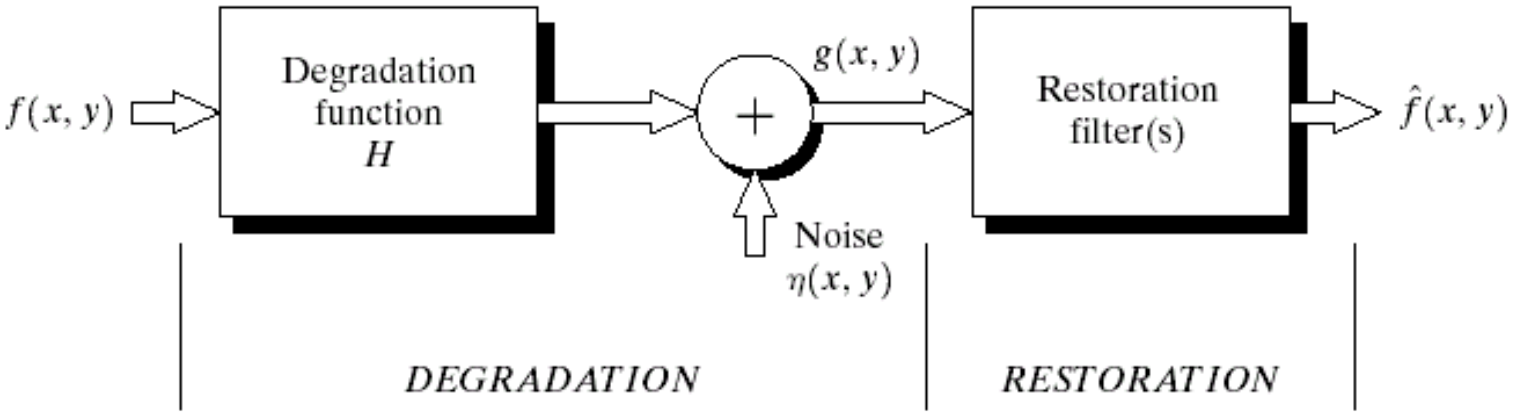


FIGURE 5.1 A model of the image degradation/ restoration process.

(Source: Gonzalez and Woods)

Image Restoration

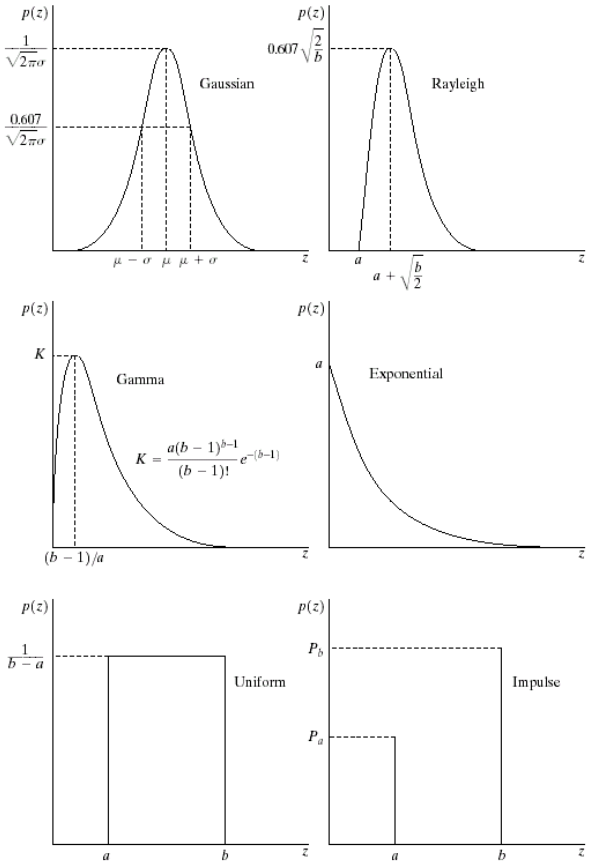
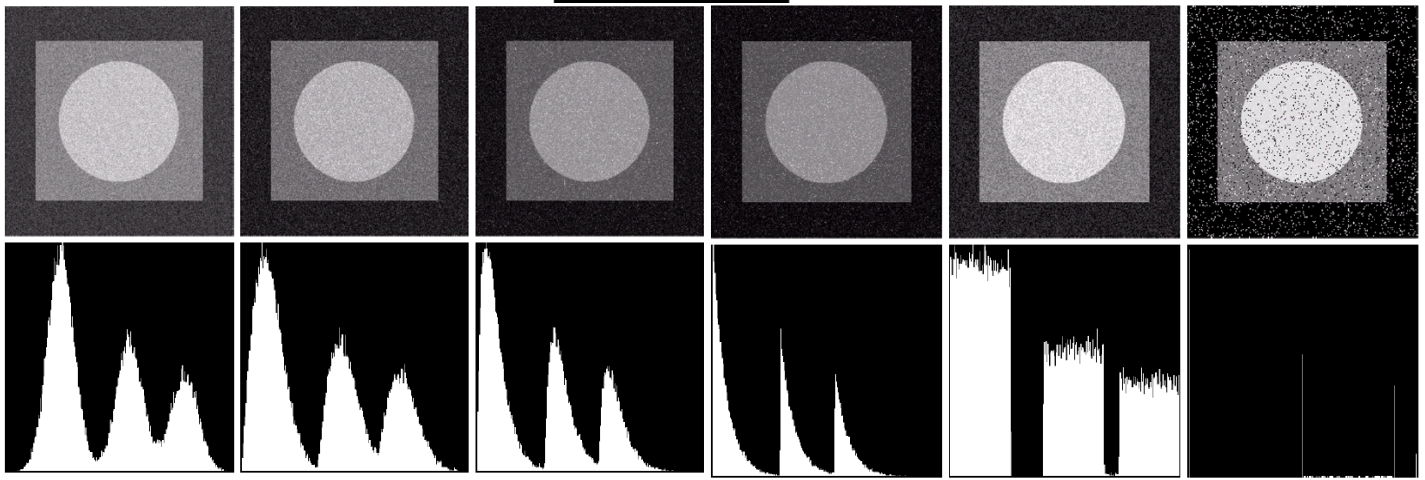


Image Restoration

Noise Free Image

Noised Images



a b c
d e f

FIGURE 5.4 Images and histograms resulting from adding Gaussian, Rayleigh, and gamma noise to the image in Fig. 5.3.

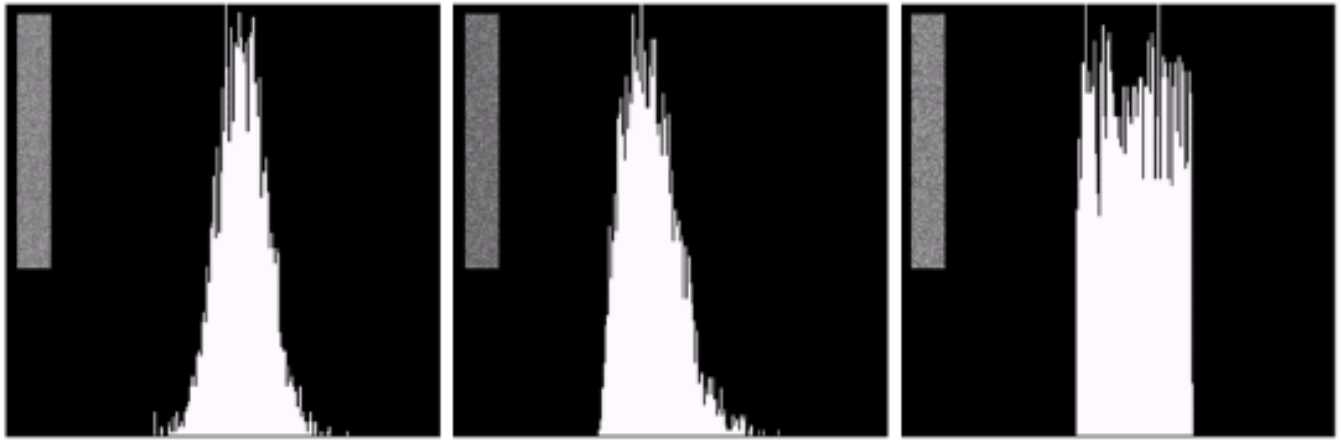
g h i
j k l

FIGURE 5.4 *(Continued)* Images and histograms resulting from adding exponential, uniform, and impulse noise to the image in Fig. 5.3.

Image Restoration

Noise Free Image

Noised Images



a b c

FIGURE 5.6 Histograms computed using small strips (shown as inserts) from (a) the Gaussian, (b) the Rayleigh, and (c) the uniform noisy images in Fig. 5.4.

Image Restoration

Process:
Observe and estimate noise type and parameters apply optimal (spatial) filtering (if known) observe result, adjust filter type/parameters …

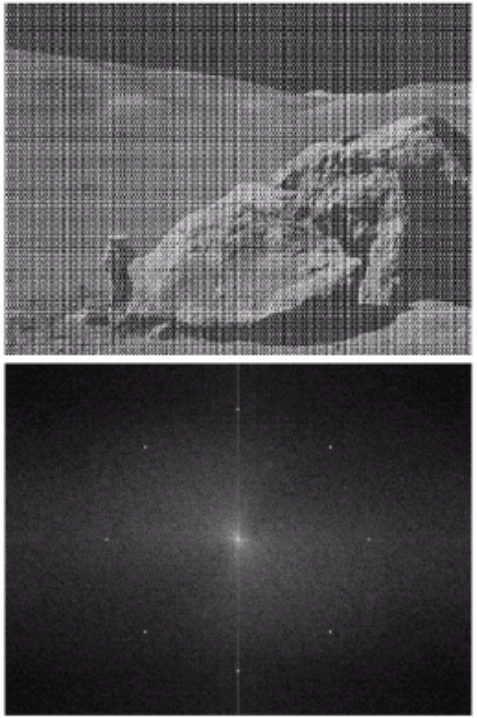
More like enhancement.

Filters: Mean, Median, Gaussian, …

Image Restoration

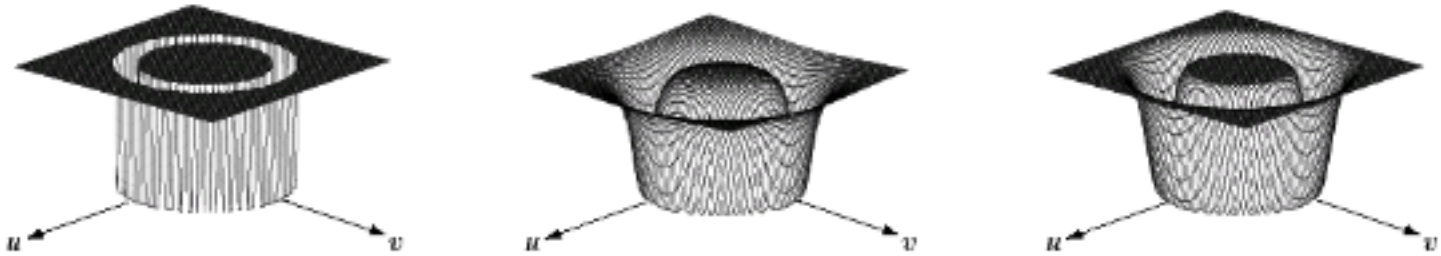
a
b

FIGURE 5.5
(a) Image corrupted by sinusoidal noise. (b) Spectrum (each pair of conjugate impulses corresponds to one sine wave). (Original image courtesy of NASA.)



(Source: Gonzalez and Woods)

Image Restoration

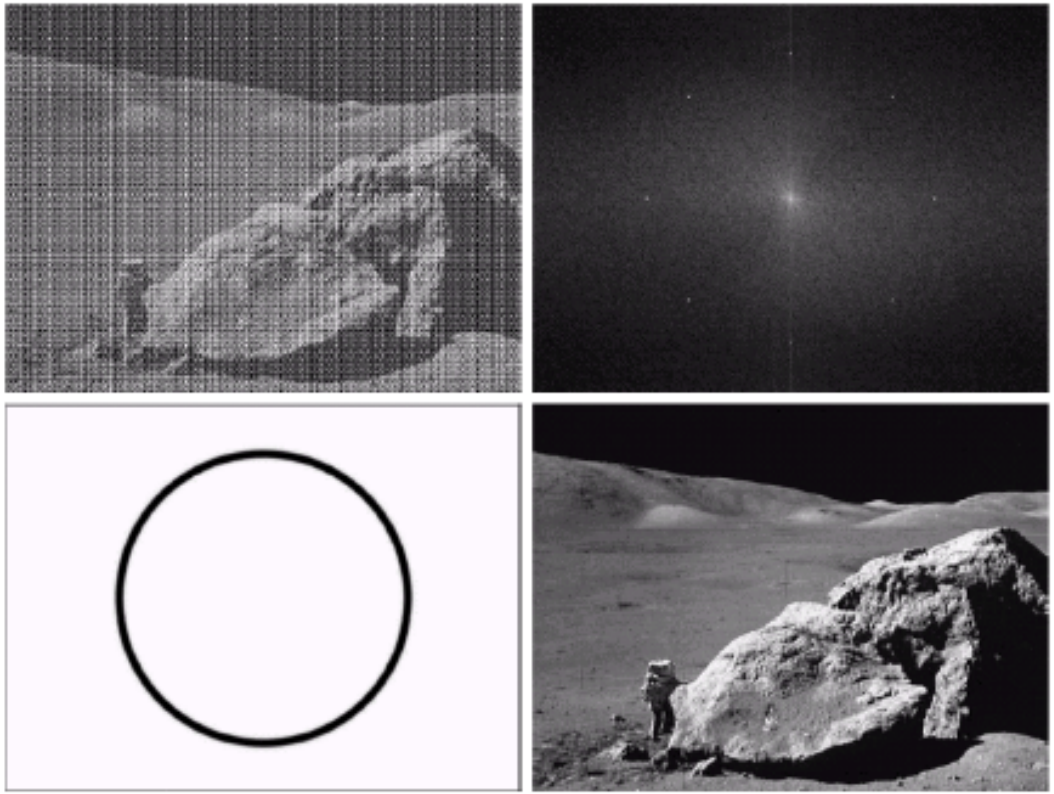


a b c

FIGURE 5.15 From left to right, perspective plots of ideal, Butterworth (of order 1), and Gaussian bandreject filters.

(Source: Gonzalez and Woods)

Image Restoration



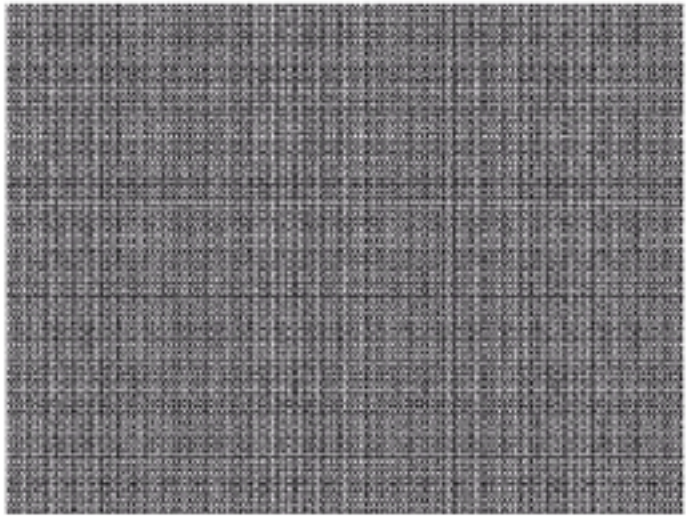
a b
c d

FIGURE 5.16
(a) Image corrupted by sinusoidal noise. (b) Spectrum of (a). (c) Butterworth bandreject filter (white represents 1). (d) Result of filtering. (Original image courtesy of NASA.)

(Source: Gonzalez and Woods)

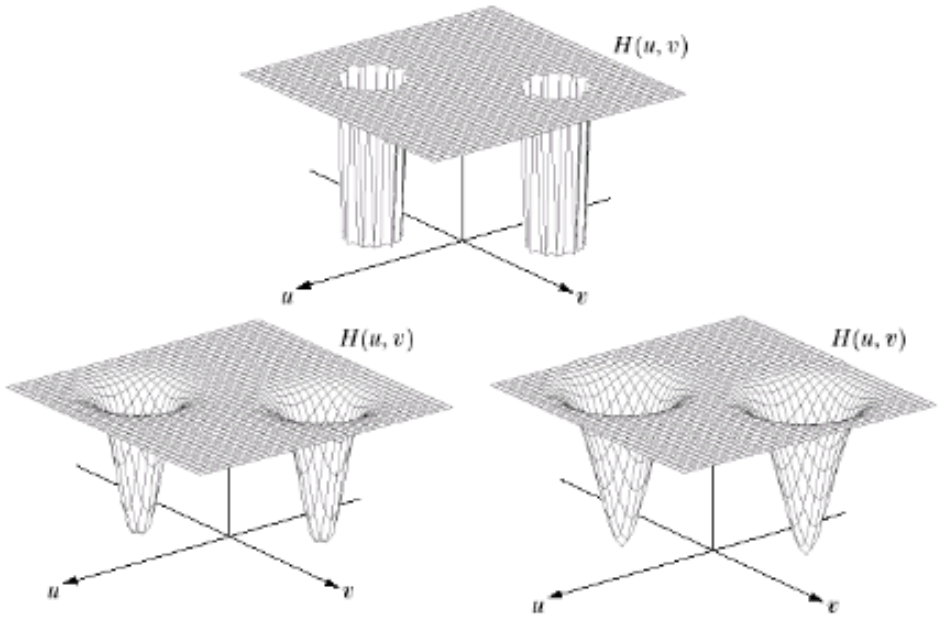
Image Restoration

FIGURE 5.17
Noise pattern of the image in Fig. 5.16(a) obtained by bandpass filtering.



(Source: Gonzalez and Woods)

Image Restoration

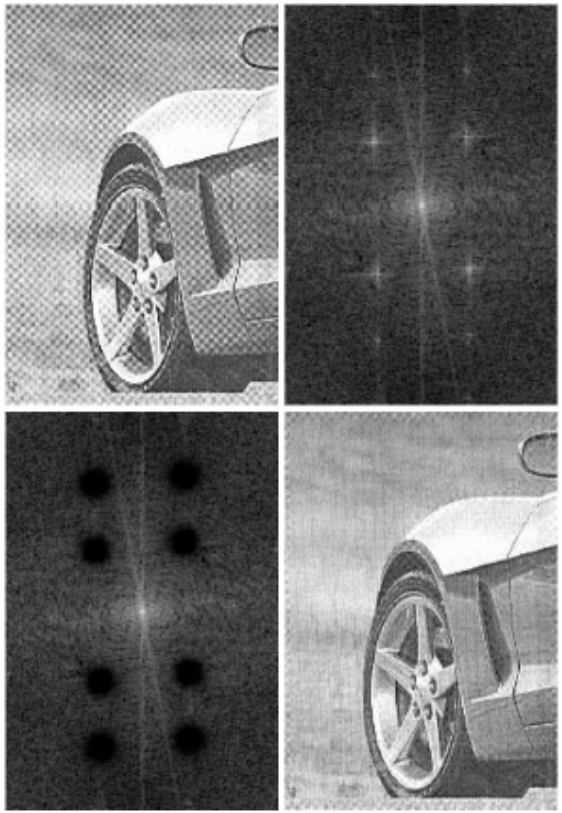


a
b c

FIGURE 5.18 Perspective plots of (a) ideal, (b) Butterworth (of order 2), and (c) Gaussian notch (reject) filters.

(Source: Gonzalez and Woods)

Image Restoration



a b
c d

FIGURE 4.64
(a) Sampled newspaper image showing a moiré pattern.
(b) Spectrum.
(c) Butterworth notch reject filter multiplied by the Fourier transform.
(d) Filtered image.

(Source: Gonzalez and Woods)