

MEETING 10

LECTURES: 20-23

- **Image Degradation/Restoration. Noise Models. Restoration in the Presence of Noise. Filters.**
- **Periodic Noise reduction by Frequency Domain Filtering.**
- **Linear, Position-Invariant Degradation. Estimating the degradation function by Modeling.**
- **Minimum Mean Square Error Filtering. Constrained Least Square Filtering.**

Image Degradation

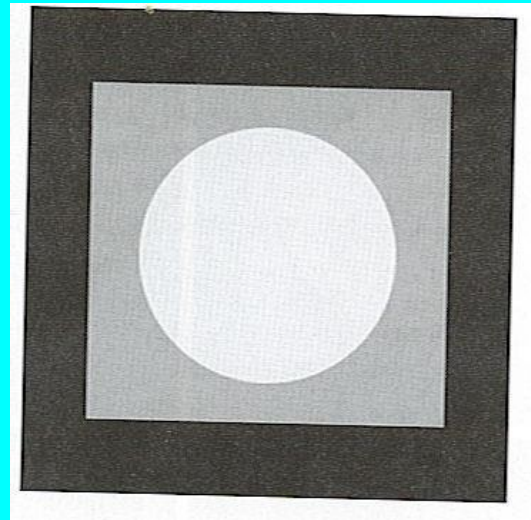


Figure 1. Test image to be used for adding noise.

(Digital Image Processing, 2nd E, by Gonzalez, Richard.)

Image Degradation

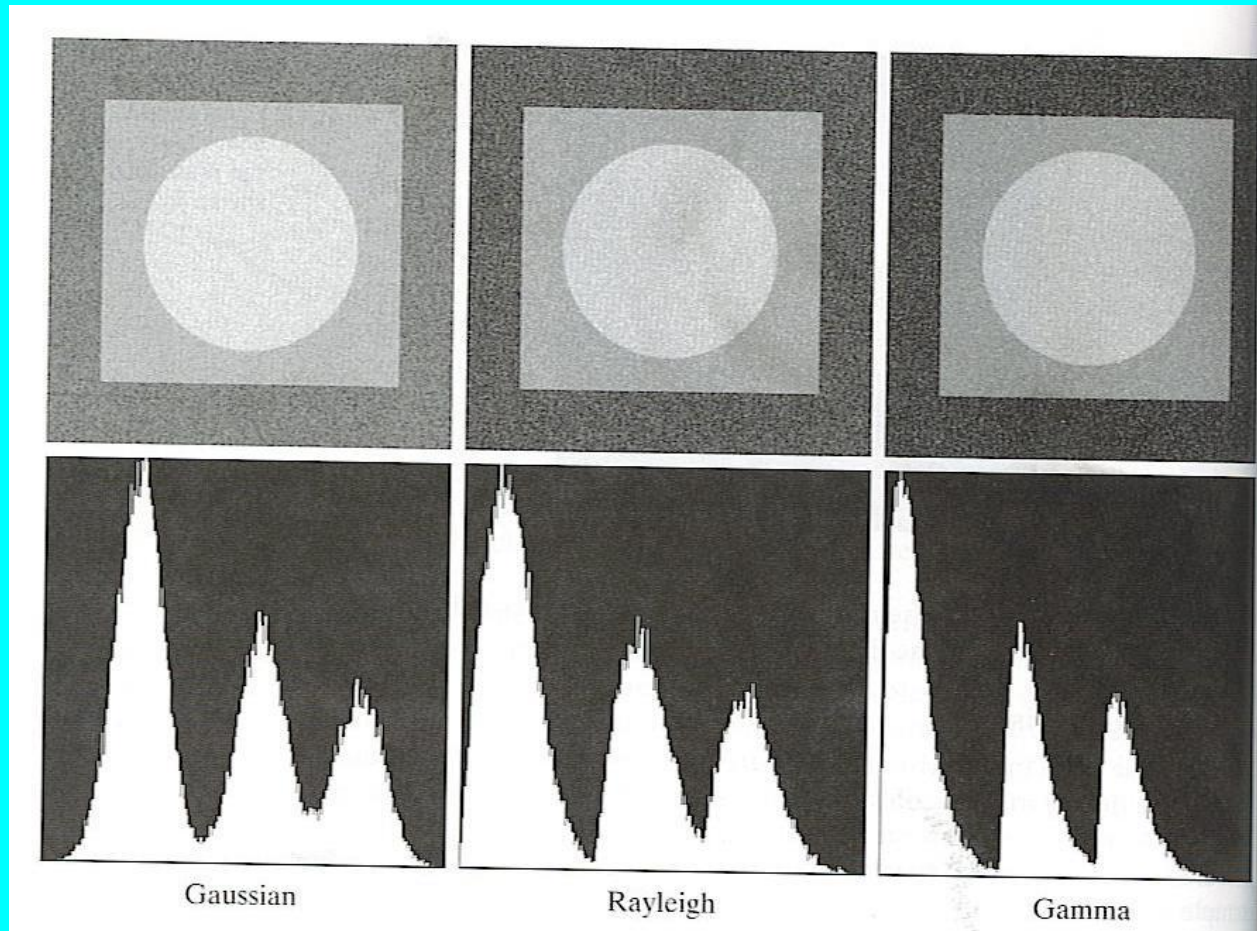


Figure 2. Top row - the image from Fig.1 and its (middle row) histogram resulting from adding noise (given in the bottom row).

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

Adding noise

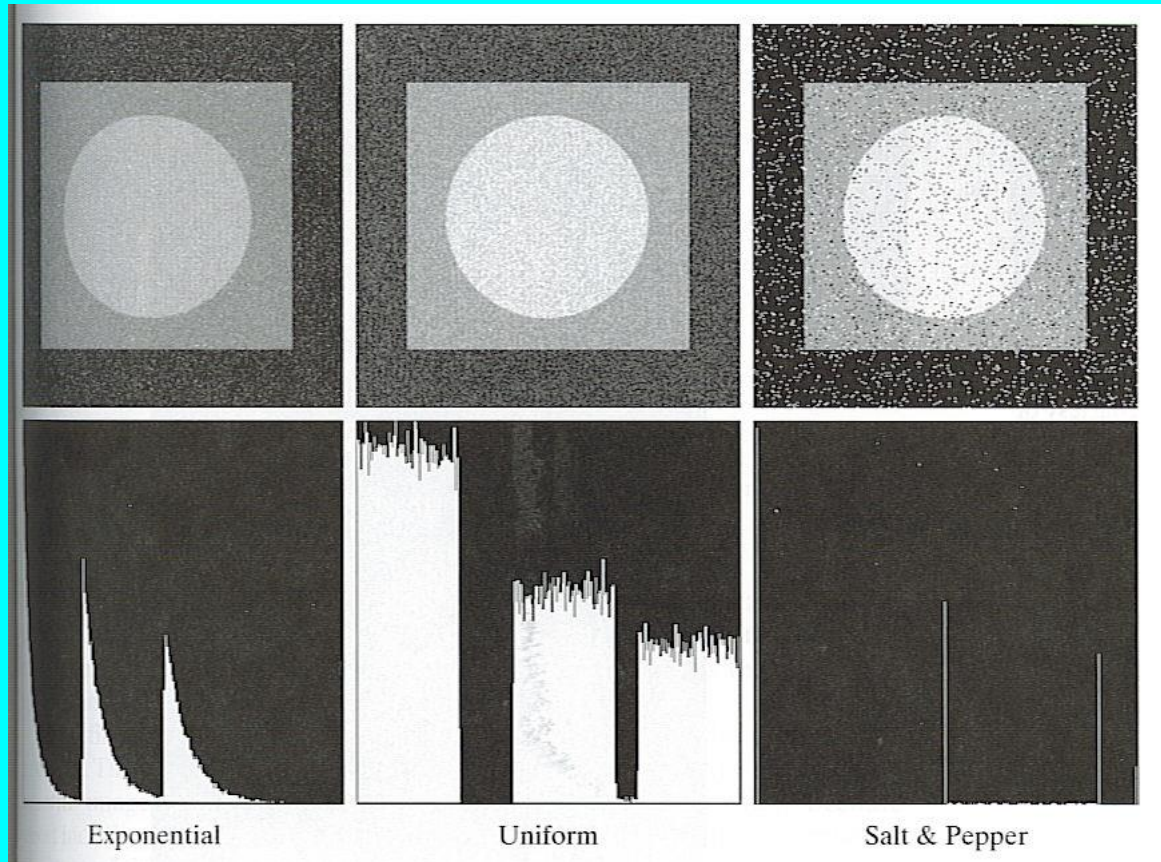


Figure 3. Top row - the image from Fig.1 and its (middle row) histogram resulting from adding noise (given in the bottom row).

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

Adding noise, and filtering

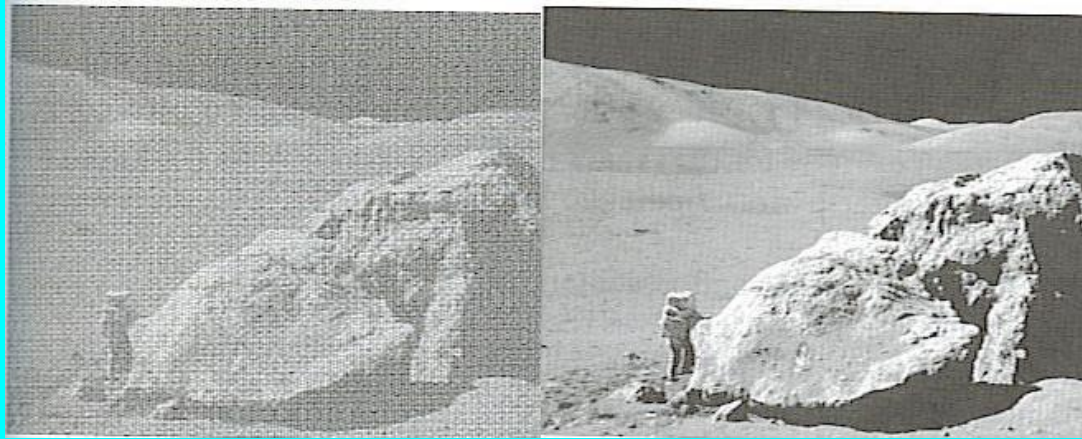


Figure 4. Left-An image corrupted with sinusoidal noise; Right- the filtered version.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

Adding noise, and filtering

a) b)
c) d)

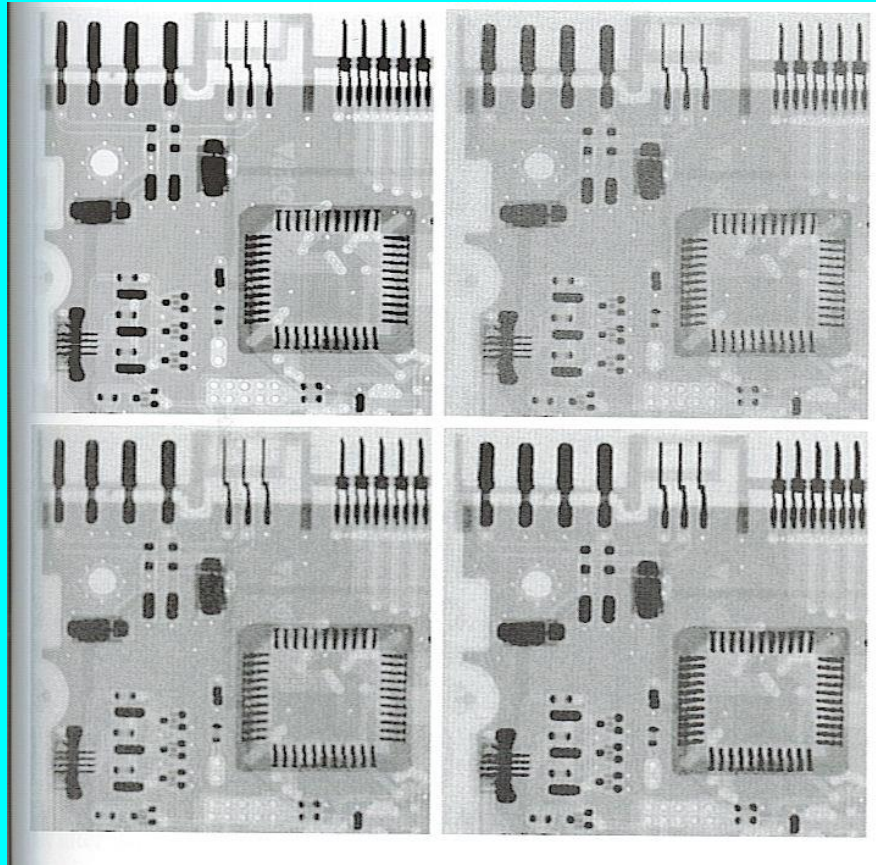


Figure 5. a) The original image; b) Corrupted with additive Gaussian; c) Processed with arithmetic mean filter of size 3x3; d) geometric mean of the same size.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

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Turbulence Model



a) b)
c) d)

Figure 1. Illustration of the atmospheric turbulence model

a) Negligible turbulence; b) severe $k=0.0025$; c) mild $k=0.001$; d) low $k=0.00025$.

(Digital Image Processing, 2nd E, by Gonzalez, Richard.)

Blurring



a)

b)

Figure 2. a) original image; b) blurred with time degradation function.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

Filtering

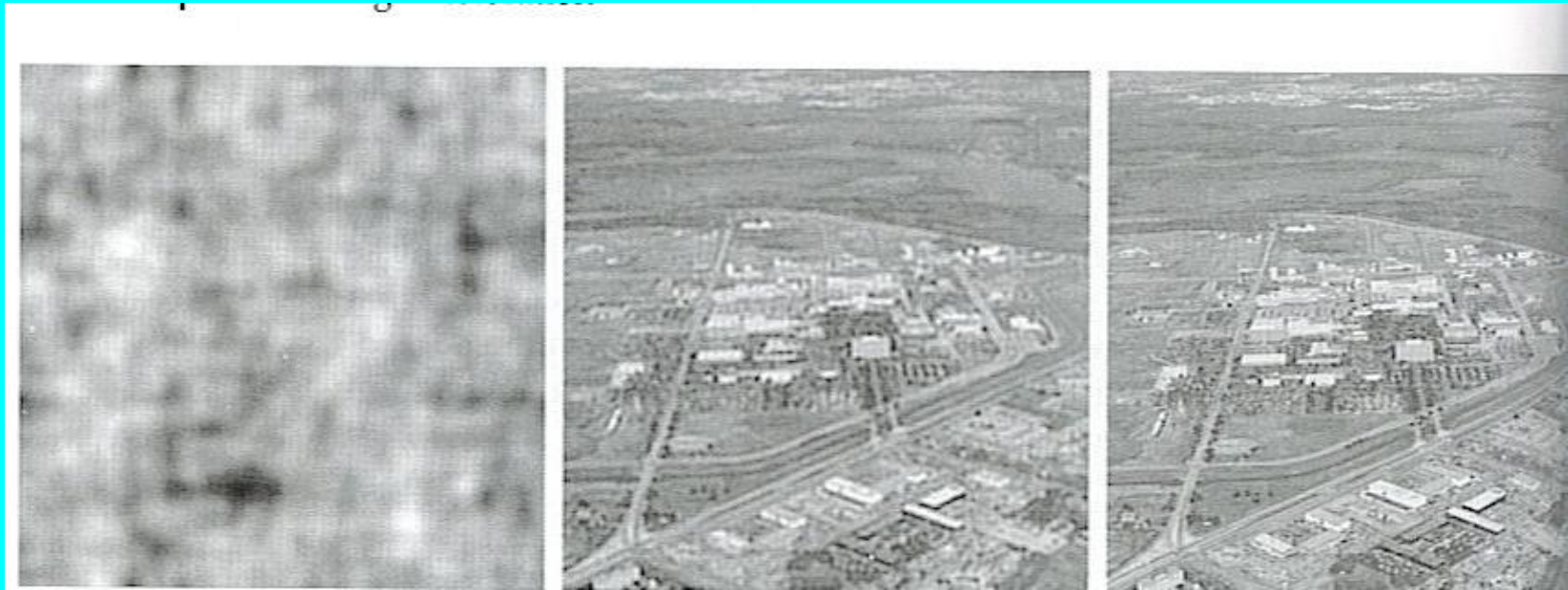


Figure 3. most left) full inverse filtering of Fig.1b); most right) result of Wiener filter.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

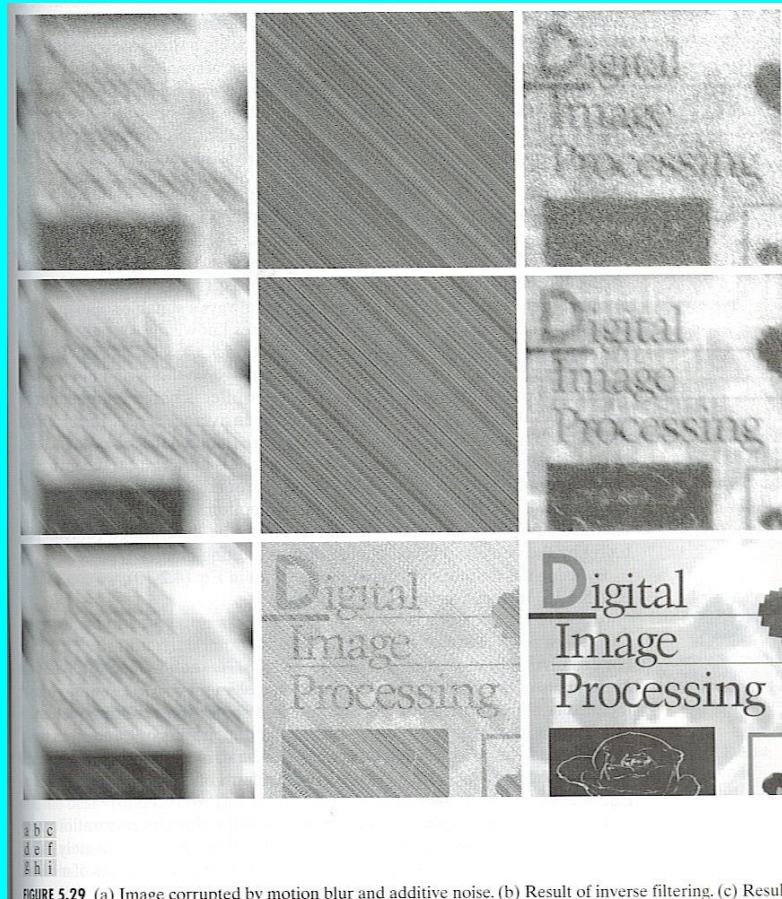


Figure 4. Image Corrupter by motion blur and adaptive noise.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).

Filtering



Figure 5. Results of constrained least square filtering.

(Digital Image Processing, 2nd E, by Gonzalez, Richard).