Image Restoration vs. Image Enhancement

- Unlike enhancement, improve an image in an objective sense
- Model the degradation and use the model for image restoration
Model of Image Degradation/Restoration

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

\[ g(x, y) = h(x, y) \ast f(x, y) + \eta(x, y) \]

\[ G(u, v) = H(u, v)F(u, v) + N(u, v) \]
Noise Models

Assumptions:

• Noise is independent of image coordinates
• Noise is not correlated with the image
Noise Modeling

\[ g(x, y) = h(x, y) \ast f(x, y) + \eta(x, y) \]

\[ G(u, v) = H(u, v)F(u, v) + N(u, v) \]
Noise in the Image

original image
Noise in the Image

examples of noise corrupted image
Important Noise PDFs

\[ p(z) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{(z - \mu)^2}{2\sigma^2}\right) \]
Noise in the Image

Gaussian
Important Noise PDFs

\[ p(z) = \frac{1}{b - a} \]

Uniform
Noise in the Image

Uniform
Important Noise PDFs

\[ p(z) = \begin{cases} 
  a \exp(-az) & , \ z \geq 0 \\
  0 & , \ z < 0 
\end{cases} \]
Noise in the Image
Important Noise PDFs

$p(z)$

$P_b$

$P_a$

Impulse
Noise in the Image

Salt & Pepper