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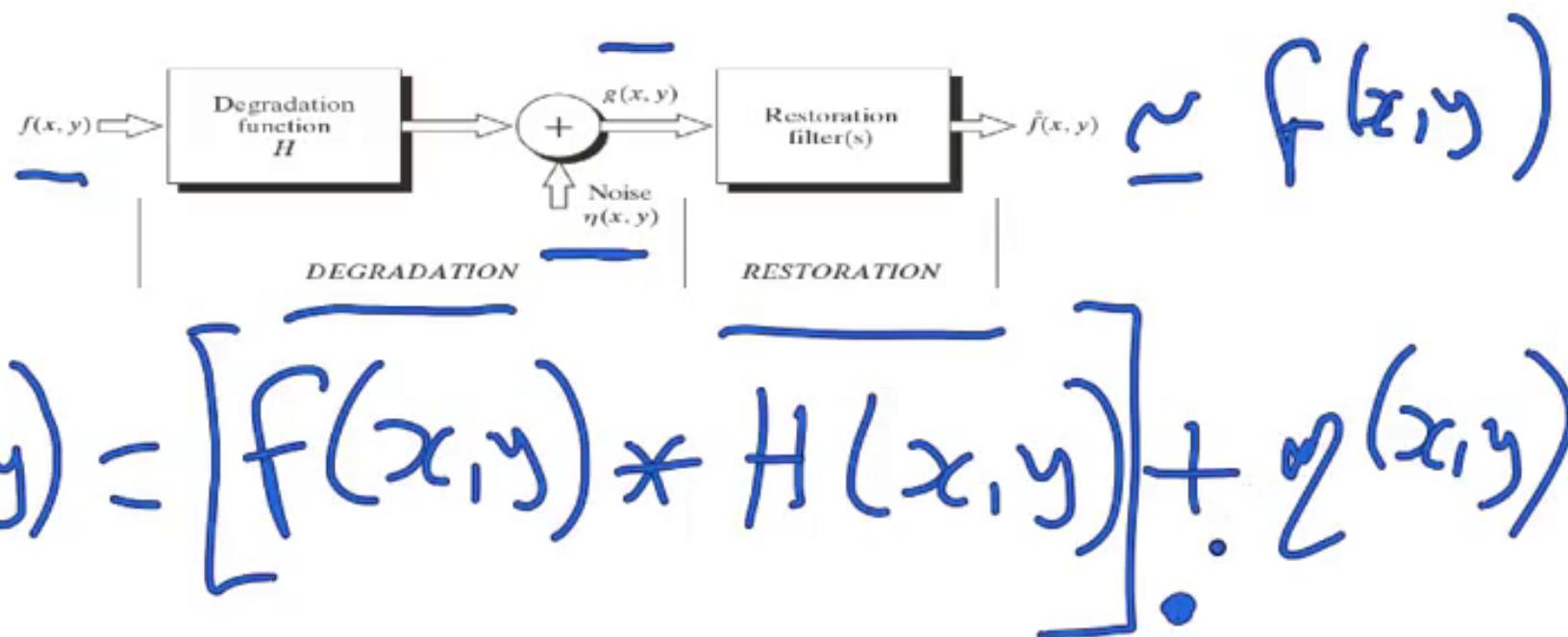
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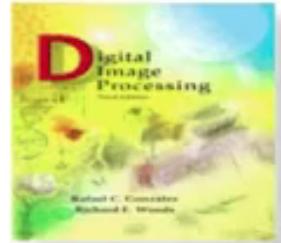
Chapter 5

Image Restoration and Reconstruction



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





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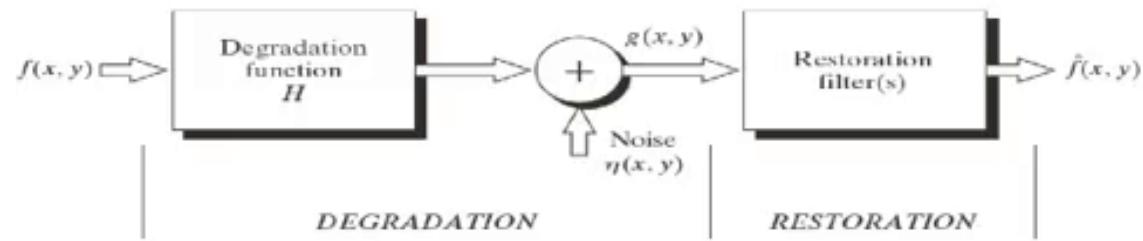
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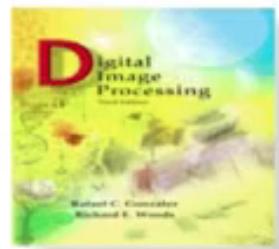
Image Restoration and Reconstruction



FIGURE 5.1
A model of the
image
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restoration
process.



$$\log(a \cdot b) = \log a + \log b$$



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$$p(z) = \frac{1}{\sqrt{2\pi}\sigma} e^{-(z-\bar{z})^2/2\sigma^2}$$

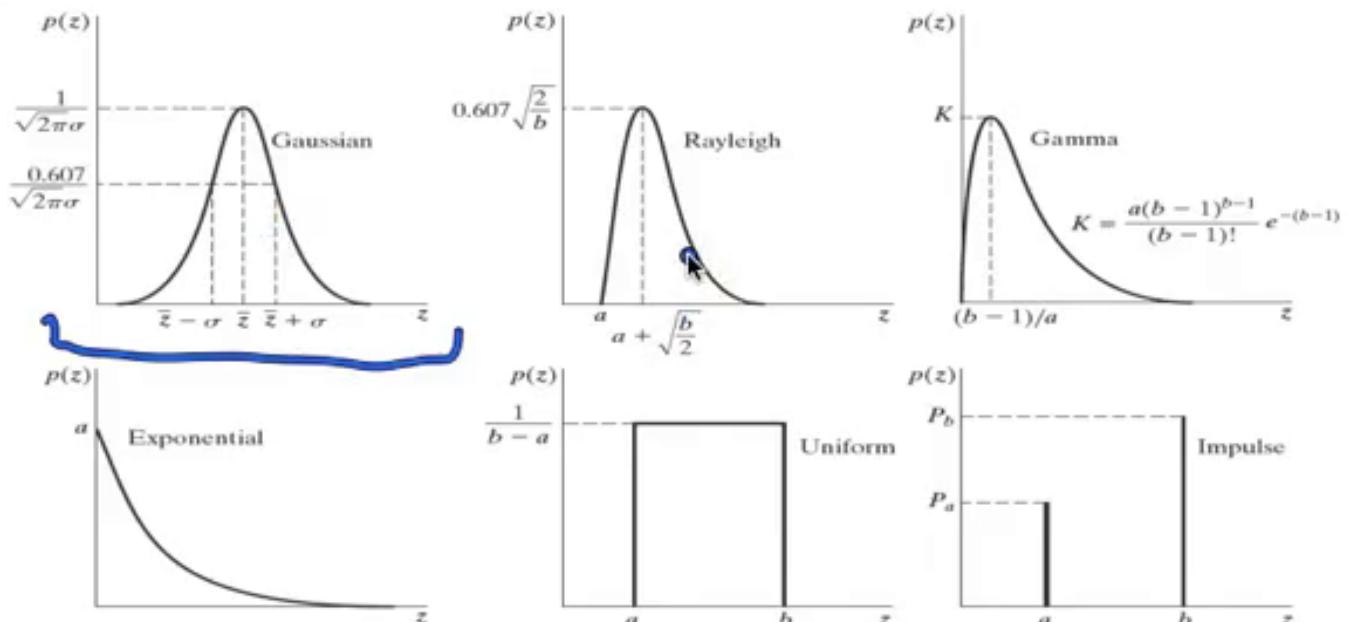
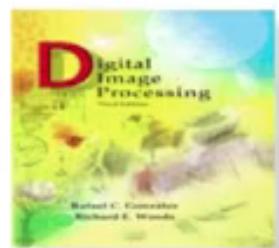


FIGURE 5.2 Some important probability density functions.



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$$q(z) = \begin{cases} \frac{2}{b} (z-a) e^{-\frac{(z-a)^2}{b}} & z \geq a \\ 0 & z \leq a \end{cases}$$

$$\bar{z} = a + \sqrt{\frac{\pi b}{4}}$$
$$\sigma^2 = b(4 - \frac{\pi}{4})$$

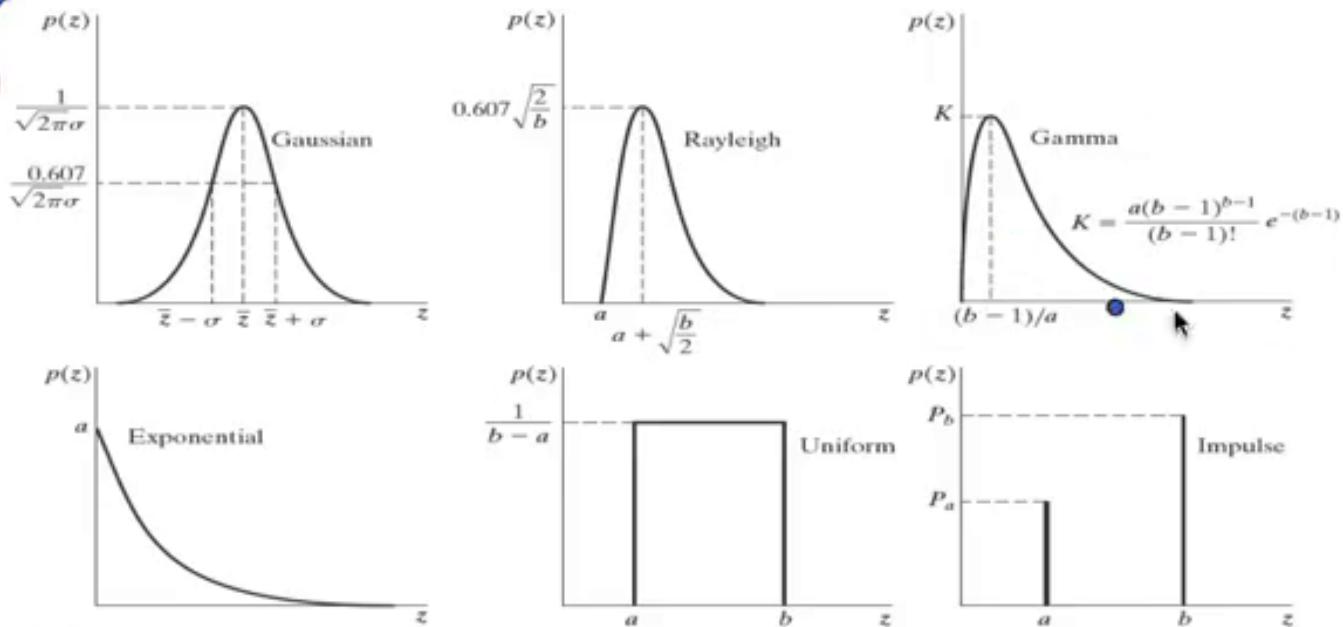
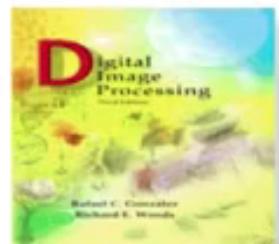


FIGURE 5.2 Some important probability density functions.



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$$p(z) = \begin{cases} a e^{-az} & z \geq 0 \\ 0 & z < 0 \end{cases}$$

$$\bar{z} = \frac{1}{a}$$

$$\sigma^2 = 1/a^2$$

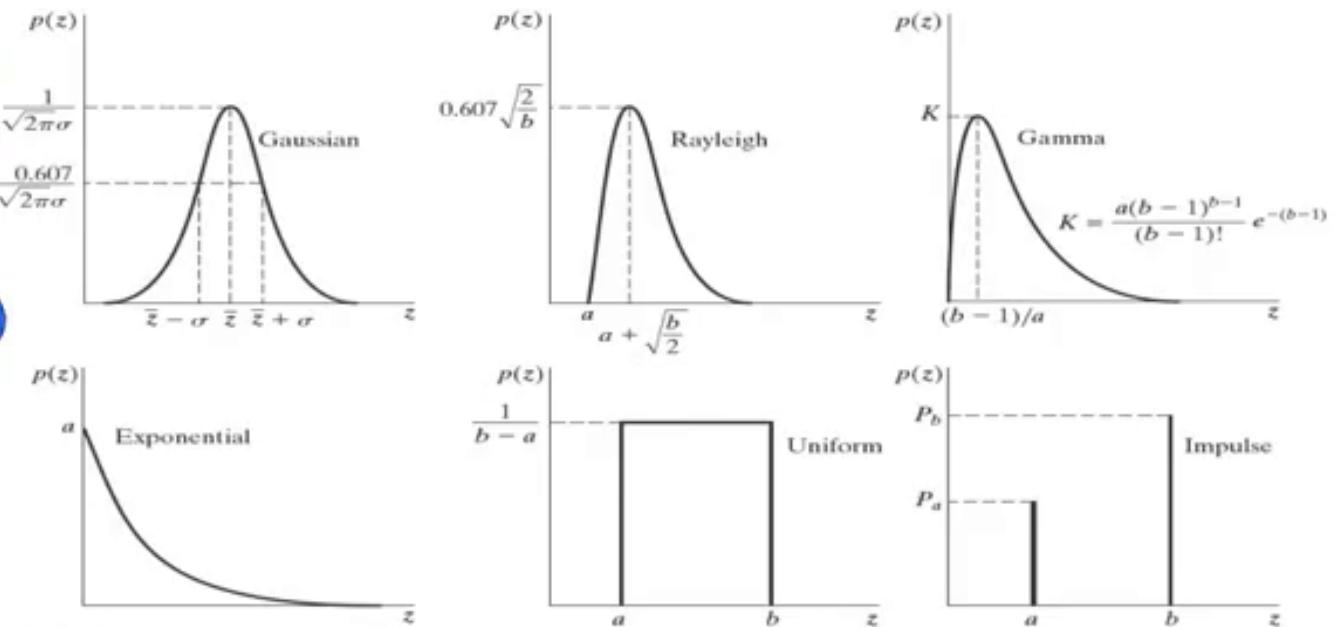
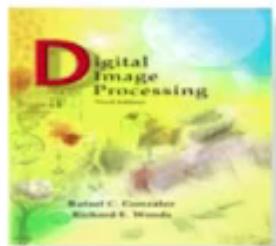


FIGURE 5.2 Some important probability density functions.



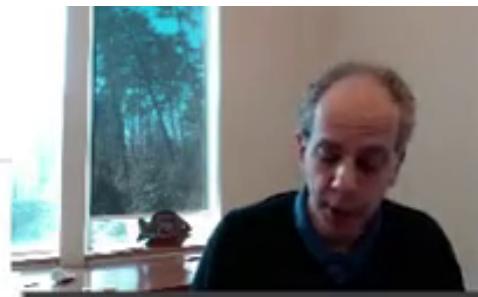
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$$p(z) = \begin{cases} \frac{1}{b-a} & a \leq z \leq b \\ 0 & \text{otherwise} \end{cases}$$

$$\bar{z} = \frac{a+b}{2}$$

$$\sigma^2 = ?$$

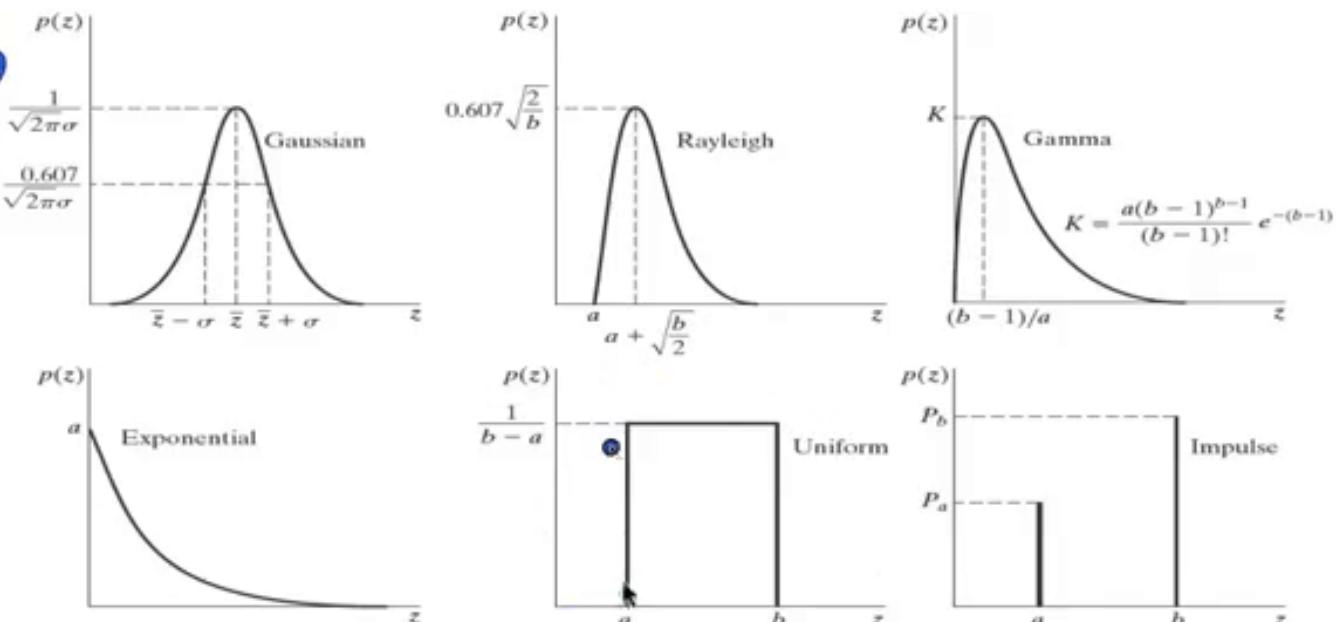
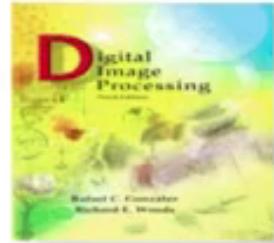


FIGURE 5.2 Some important probability density functions.



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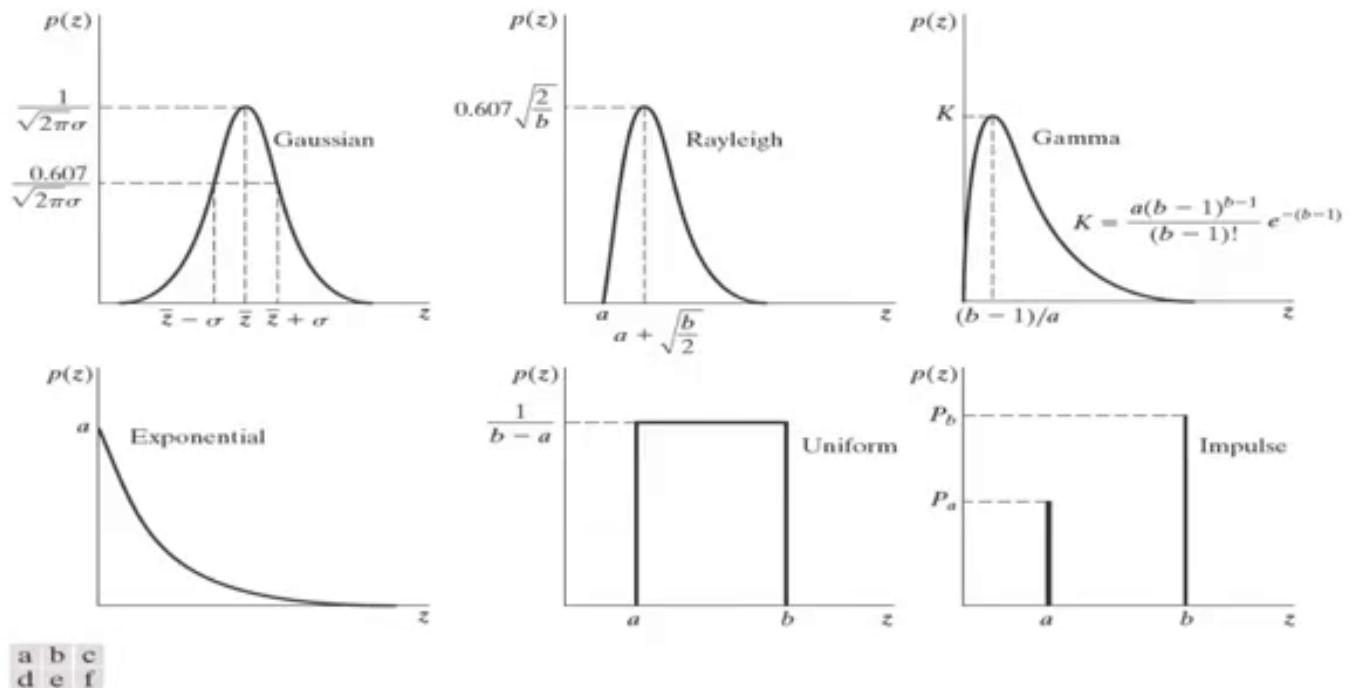


FIGURE 5.2 Some important probability density functions.

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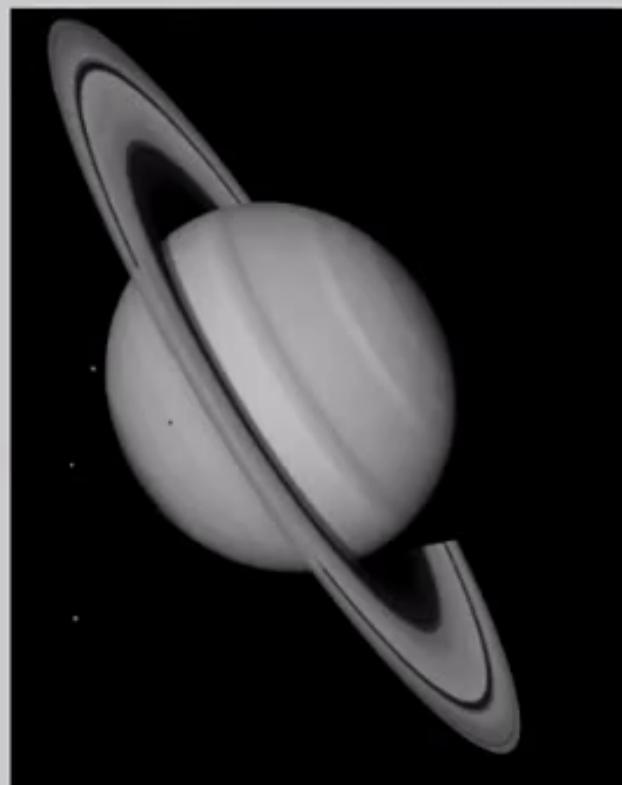
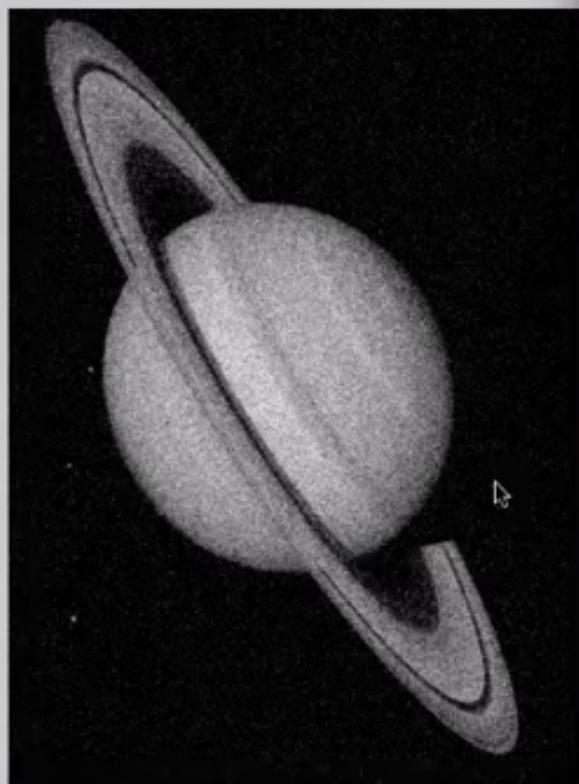


Name	Value
I	<150
I2	<150
I2O	<150
I2G	<150
RGB	<150

```
x * -- Command...  
I = imread('ei  
J = imnoise(I,  
K = medfilt2(J  
figure, imshow  
+ %-- 11/23/12 7:01  
I = imread('ei  
J = imnoise(I,  
K = medfilt2(J  
figure, imshow  
+ %-- 11/23/12 7:11  
RGB = imread('  
I = rgb2gray(R  
I2 = imnoise(I  
I20 = imnoise(  
I2G = imnoise(  
RGB = imread('  
I = rgb2gray(R  
I2G = imnoise(  
I2 = imnoise(I  
I20 = imnoise(
```



Edit View Insert Tools Desktop Window Help

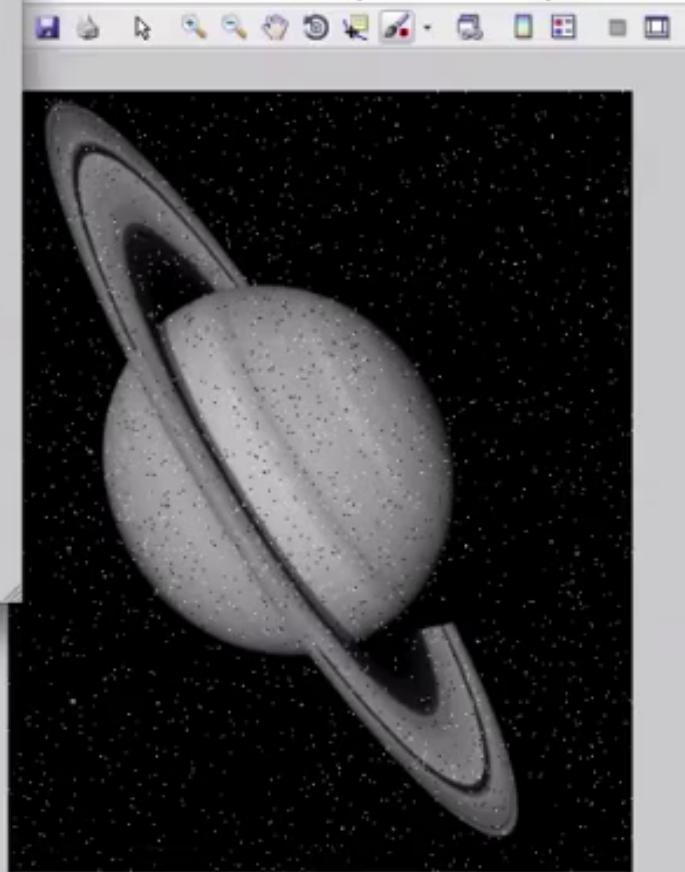


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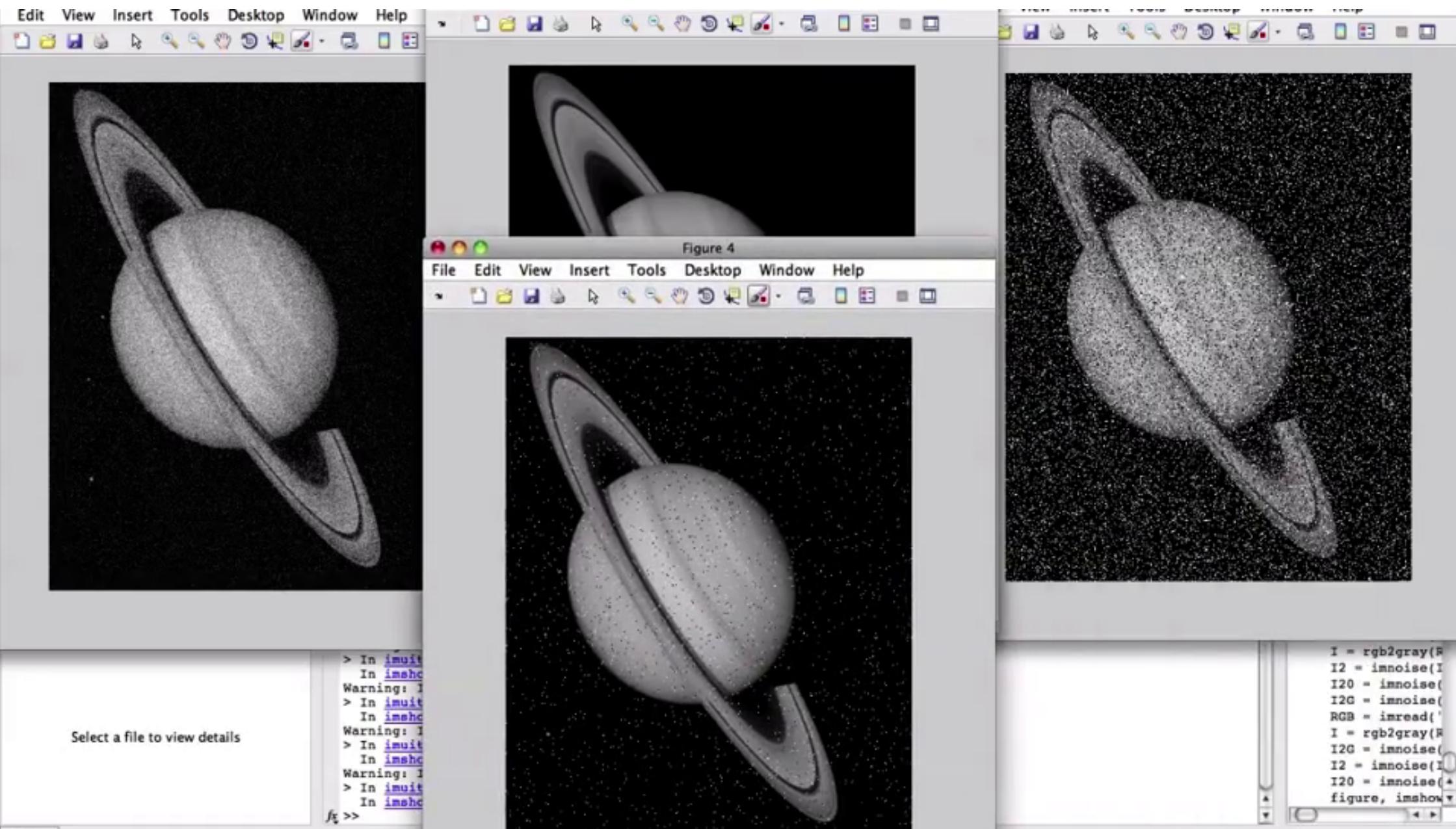
Figure 4

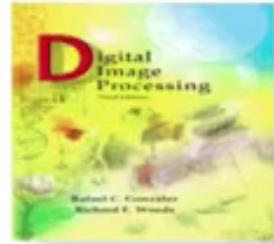
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```
g to fit on screen; displaying at 33%
> In imuitools/private/initSize at 73
  In imshow at 262
Warning: Image is too big to fit on screen; displaying at 33%
> In imuitools/private/initSize at 73
  In imshow at 262
Warning: Image is too big to fit on screen; displaying at 33%
> In imuitools/private/initSize at 73
  In imshow at 262
Warning: Image is too big to fit on screen; displaying at 33%
> In imuitools/private/initSize at 73
  In imshow at 262
f> >>
```





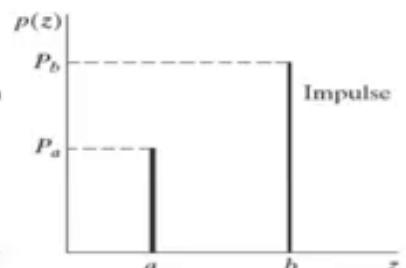
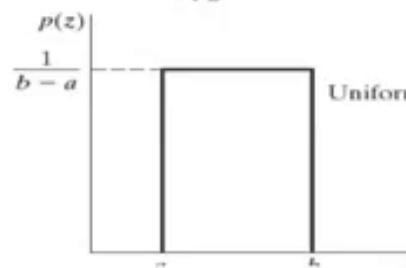
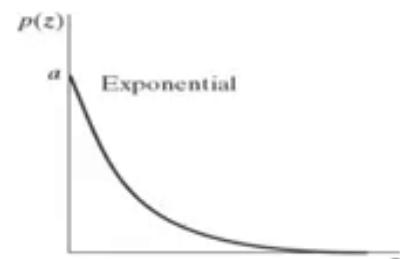
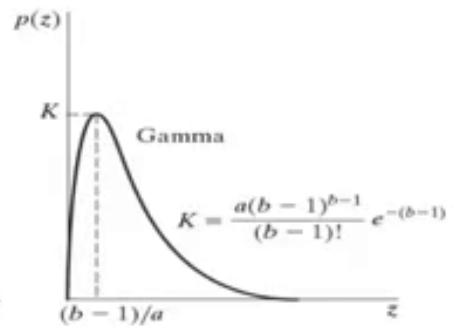
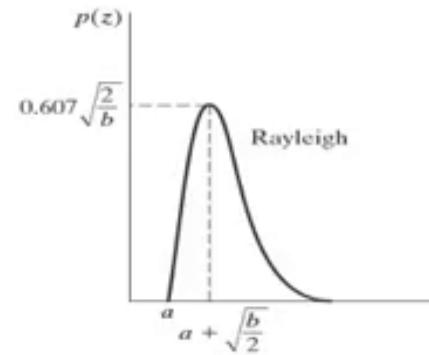
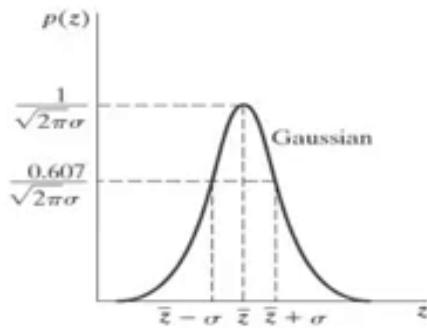
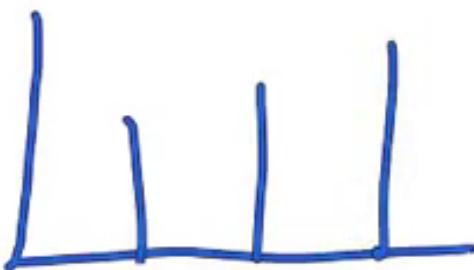
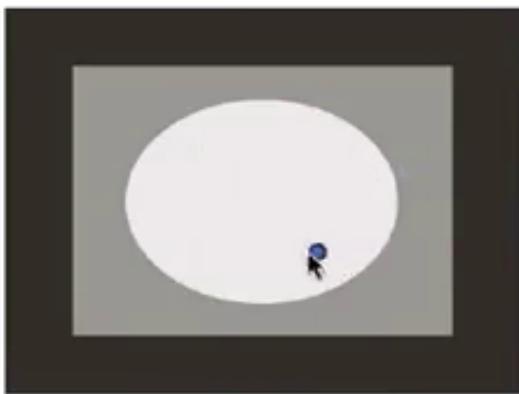
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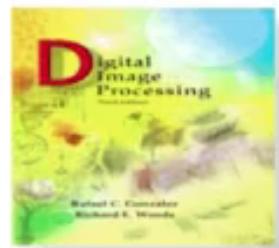
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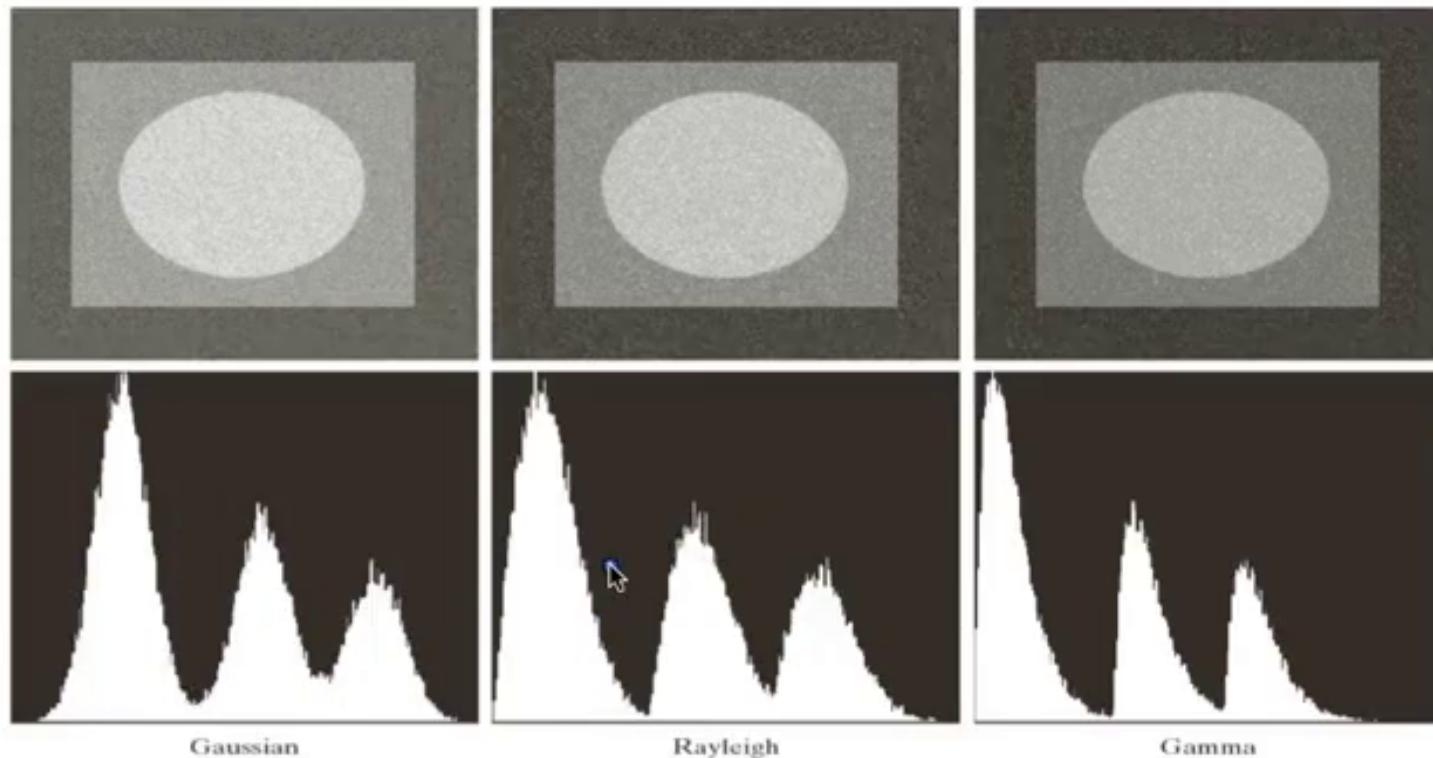
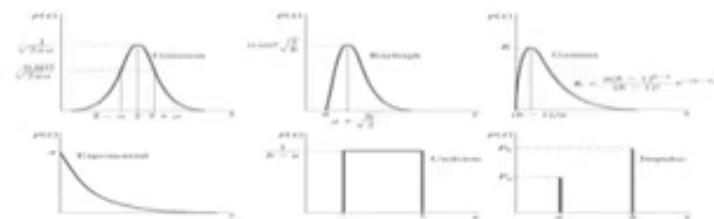
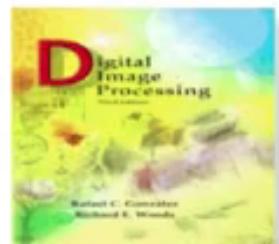


FIGURE 5.4 Images and histograms resulting from adding Gaussian, Rayleigh, and gamma noise to the image in Fig. 5.3.

a
b
c
d
e
f



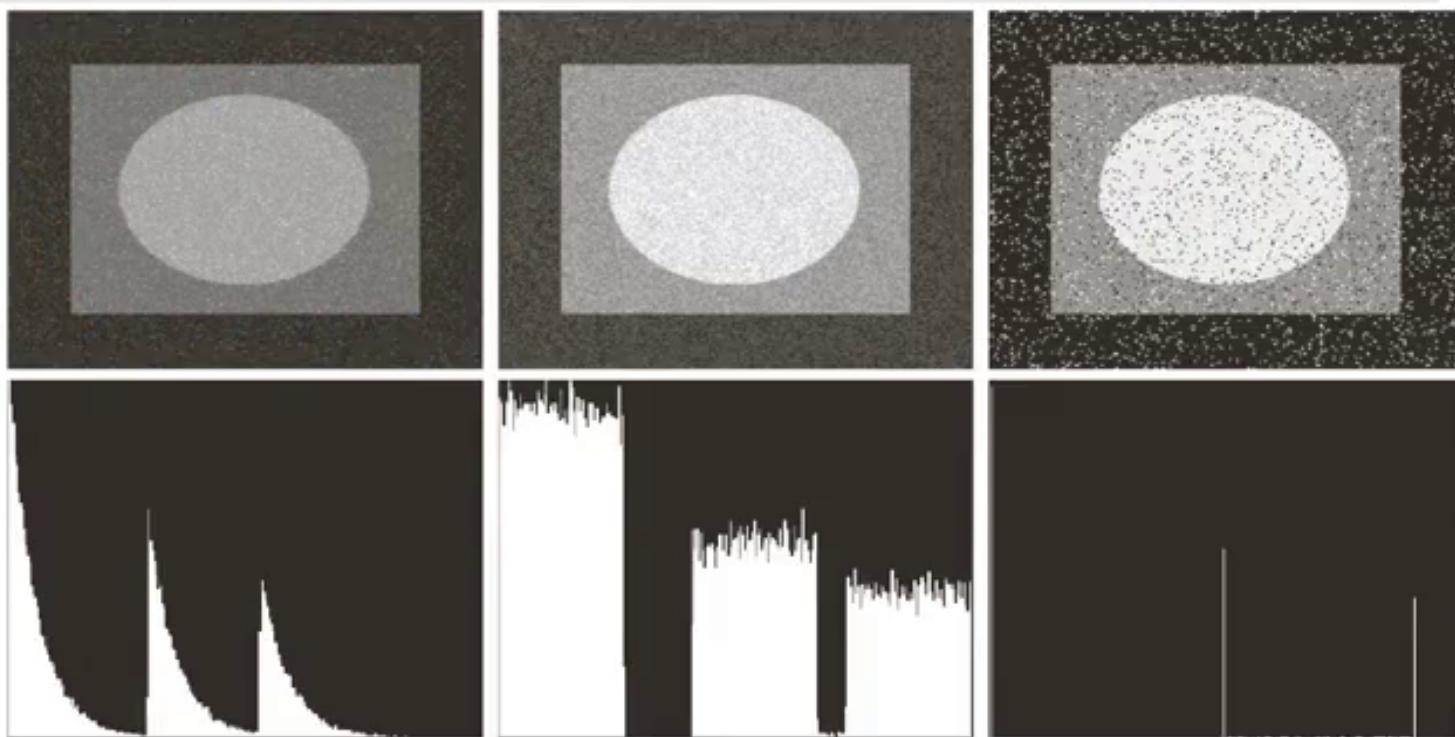
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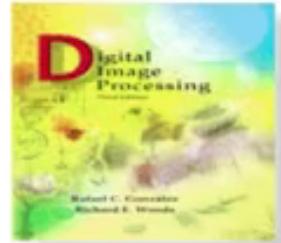
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Image Restoration and Reconstruction



Salt & Pepper

uniform, and salt and



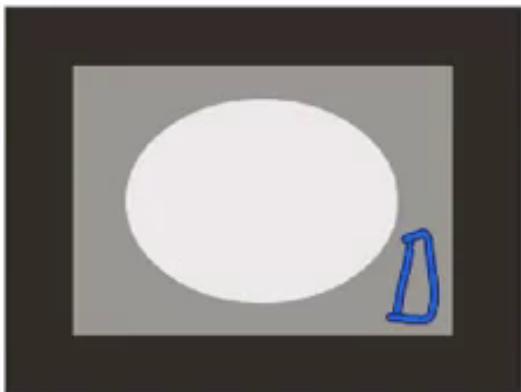
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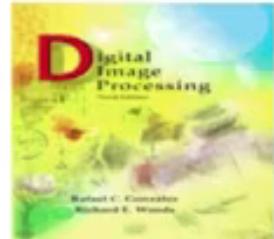
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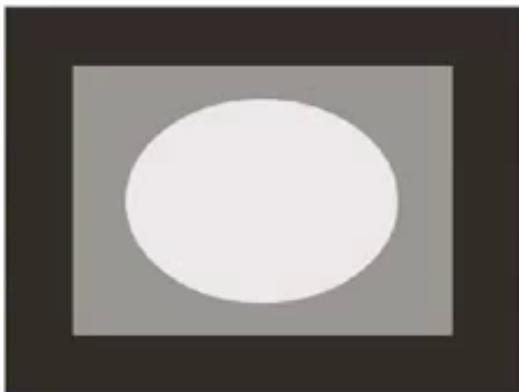
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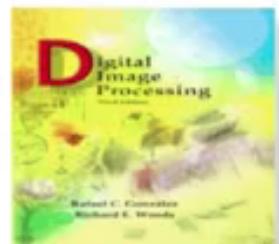
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$$\begin{aligned} g(x,y) &= f(x,y) + \eta(x,y) \\ \|\tilde{f}(x,y) - \tilde{g}(x,y)\|^2. \end{aligned}$$



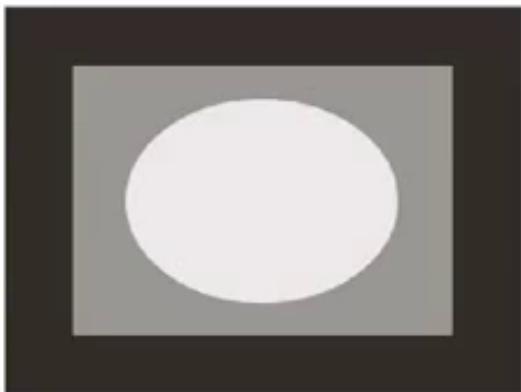
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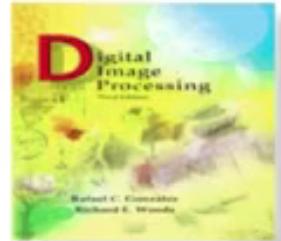
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Image Restoration and Reconstruction



$$\|\tilde{f} - g\|$$

$$g(x,y) = f(x,y) + \eta(x,y)$$
$$\|\tilde{f}(x,y) - \tilde{g}(x,y)\|^2$$



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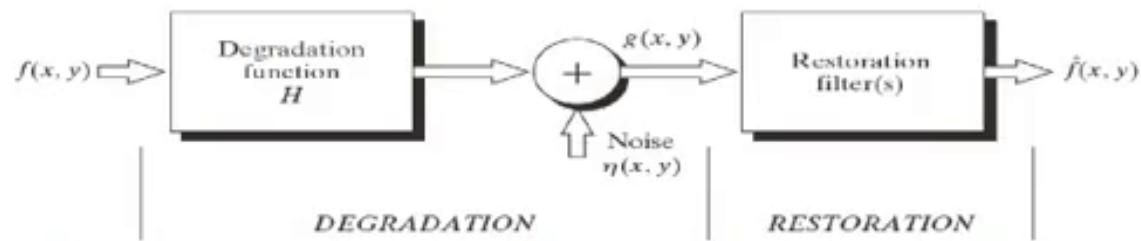
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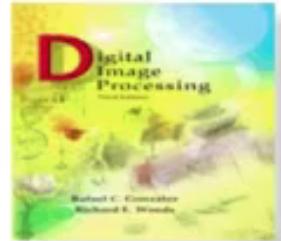
Image Restoration and Reconstruction



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



$$g(x, y) = f(x, y) * h(x, y) + \eta(x, y)$$
$$G(u, v) = F(u, v) \cdot H(u, v)$$
$$F(u, v) = \frac{G(u, v)}{H(u, v)}$$



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a b

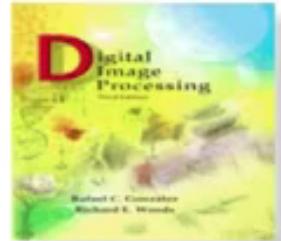
FIGURE 5.24
Degradation estimation by impulse characterization.
(a) An impulse of light (shown magnified).
(b) Imaged (degraded) impulse.



H
II

$$g(x,y) = f(x,y) * G(0,\sigma)$$

$$G = S(x,y) * g$$



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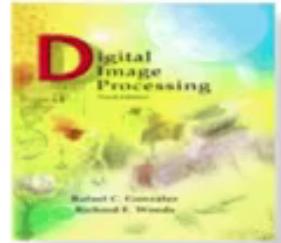
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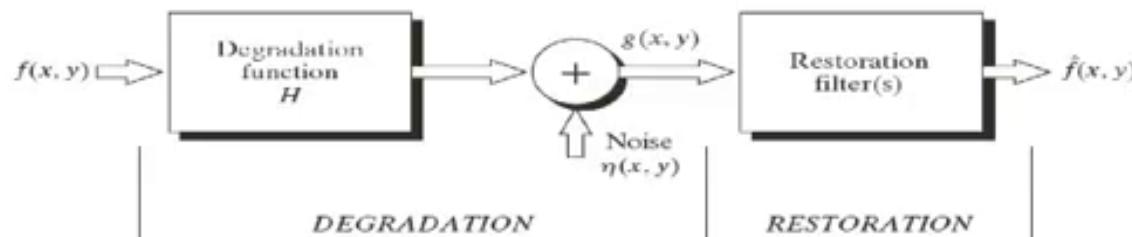
Image Restoration and Reconstruction



$$\underline{g(x,y)} = \underbrace{\int_0^T}_{0} f(x-x(t), y-y(t)) dt$$
$$G = H F$$

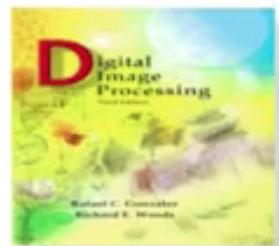


Wiener Filtering



$$e^a = E \{ [f(x,y) - \hat{f}(x,y)]^2 \}$$

$$\hat{F}(u,v) = \frac{H^*(u,v)}{H^2(u,v) + S_N/S_F} G(u,v)$$



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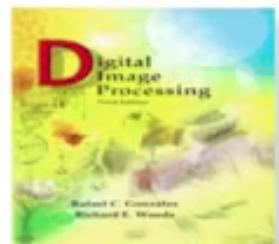
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$$\frac{1}{H} \xrightarrow{\text{Gaussian}}$$



$$\frac{H^*}{H^2 + K}$$



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$$\frac{1}{H}$$

a b c
d e f
g h i



$$\frac{H^*}{H^2 + K}$$

FIGURE 5.29 (a) 8-bit image corrupted by motion blur and additive noise. (b) Result of inverse filtering. (c) Result of Wiener filtering. (d)–(f) Same sequence, but with noise variance one order of magnitude less. (g)–(i) Same sequence, but noise variance reduced by five orders of magnitude from (a). Note in (h) how the deblurred image is quite visible through a “curtain” of noise.

Image and Video Processing: From Mars to Hollywood with a Stop at the Hospital

Guillermo Sapiro



older: /Users/guillermo_sapiro/Documents/MATLAB

Command Window

MATLAB? Watch this [Video](#), see [Demos](#), or read [Getting Started](#).

Details

Select a file to view details

Workspace

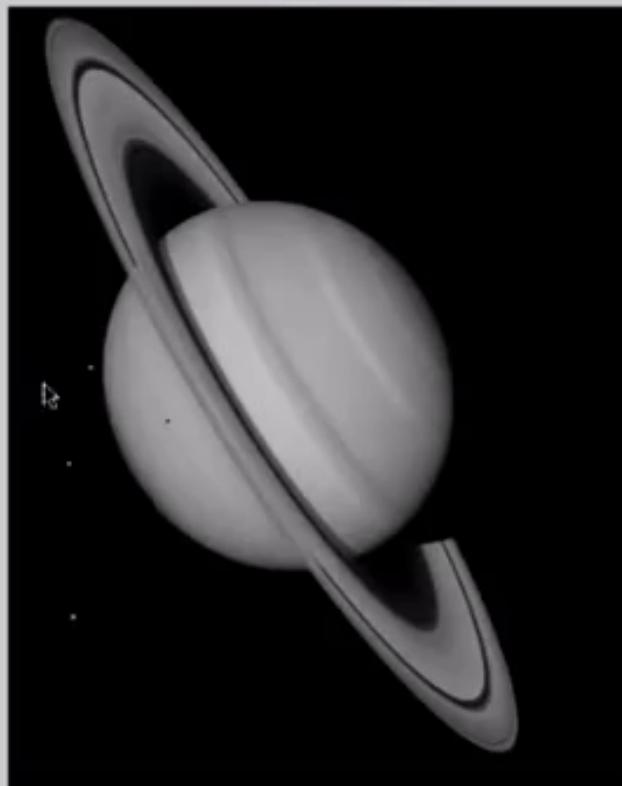
Name	Value
H	<21x
I	<150
J	<150
K	<150
RGB	<150
blurred	<150

Command History

```
RGB = imread('saturn.png');
I = rgb2gray(RGB);
J = imnoise(I,'gaussian',0,0.005);
K = wiener2(J,[10 10]);
H = fspecial('disk',10);
blurred = imfilter(J,H, 'replicate');
figure, imshow(I), figure, imshow(J), figure, imshow(blurred), figure, imshow(K)
```

t--- 11/23/12 7:5:

```
RGB = imread('saturn.png');
I = rgb2gray(RGB);
J = imnoise(I,'gaussian',0,0.005);
K = wiener2(J,[10 10]);
H = fspecial('disk',10);
blurred = imfilter(J,H, 'replicate');
```



Details

Select a file to view details

```
>> figure,  
Warning: I  
> In imui  
In imsho  
ft >>
```



```
n = wiener2(J,  
H = fspecial('  
blurred = imfi  
figure, imshow  
RGB = imread('  
I = rgb2gray(R  
J = imnoise(I,  
K = wiener2(J,  
H = fspecial('  
blurred = imfi  
figure, imshow
```

