

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



مبانی بینایی کامپیوتری

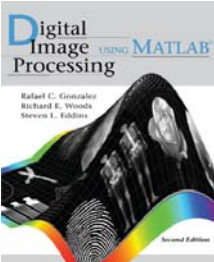
درس ۴ ب

تبدیل‌های روی شدت رنگ در متلب

Intensity Transformations in MATLAB®

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دانشگاه تهران

<http://courses.fouladi.ir/fcvision>



Chapter 3

Intensity Transformations and Spatial Filtering

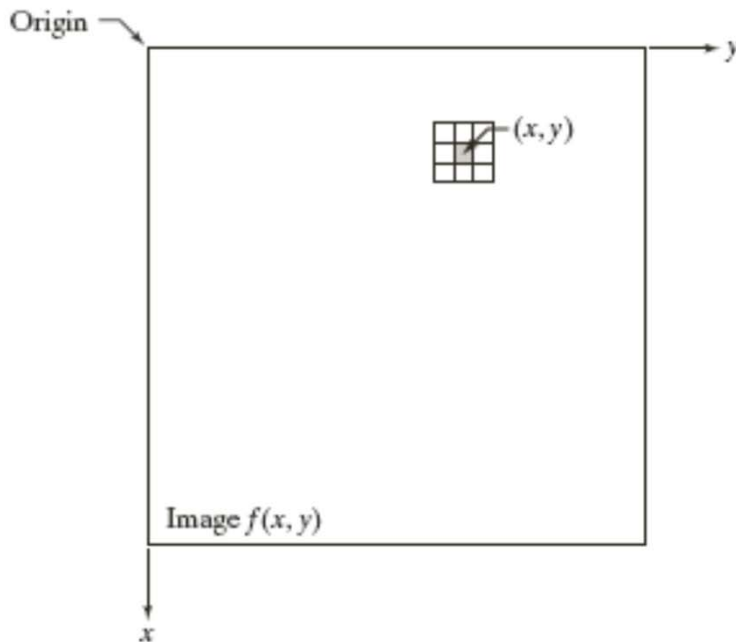
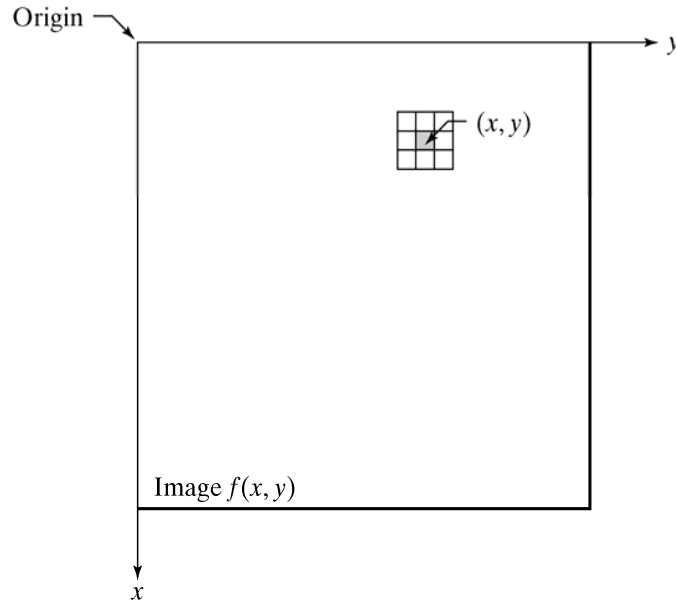


FIGURE 2.1

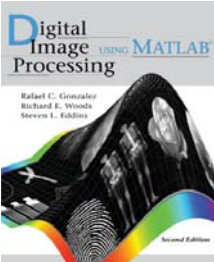
A neighborhood
of size 3×3
centered at point
 (x, y) in an image.

توابع تبدیل شدت رنگ

همسایگی حول یک نقطه



neighborhood of
size 3×3 about a
point (x, y) in an
image.

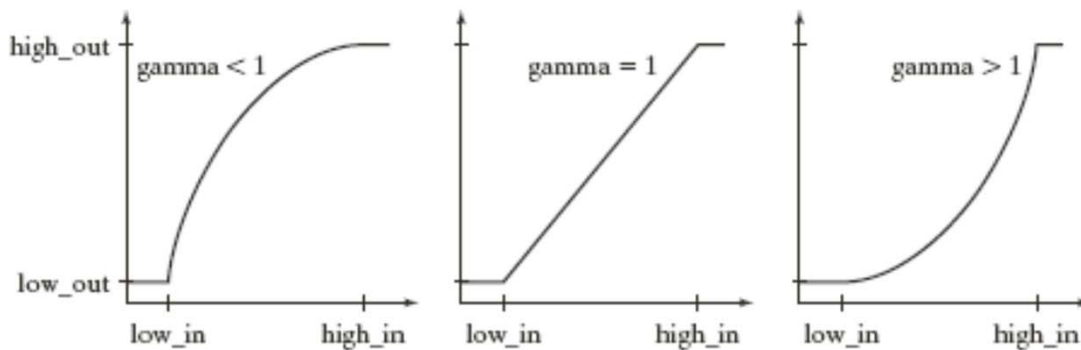


Chapter 3

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a b c

FIGURE 2.2
The various mappings available in function `imadjust`.



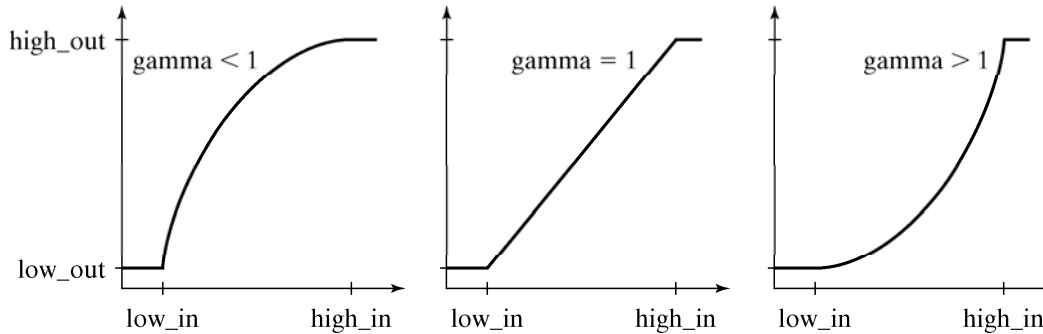
توابع تبدیل شدت رنگ

تابع تنظیم تصویر

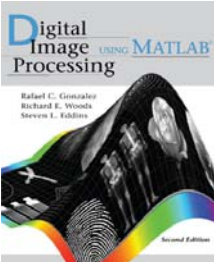
$$g = \text{imadjust}(f, [low_in \ high_in], [low_out \ high_out], \gamma)$$
$$g1 = \text{imadjust}(f, [0 \ 1], [1 \ 0])$$

توابع تبدیل شدت رنگ

تابع تنظیم تصویر: انواع نگاشت‌های ممکن با `imadjust`

$$g = \text{imadjust}(f, [low_in \ high_in], [low_out \ high_out], gamma)$$


various mappings
available in
function
`imadjust`.



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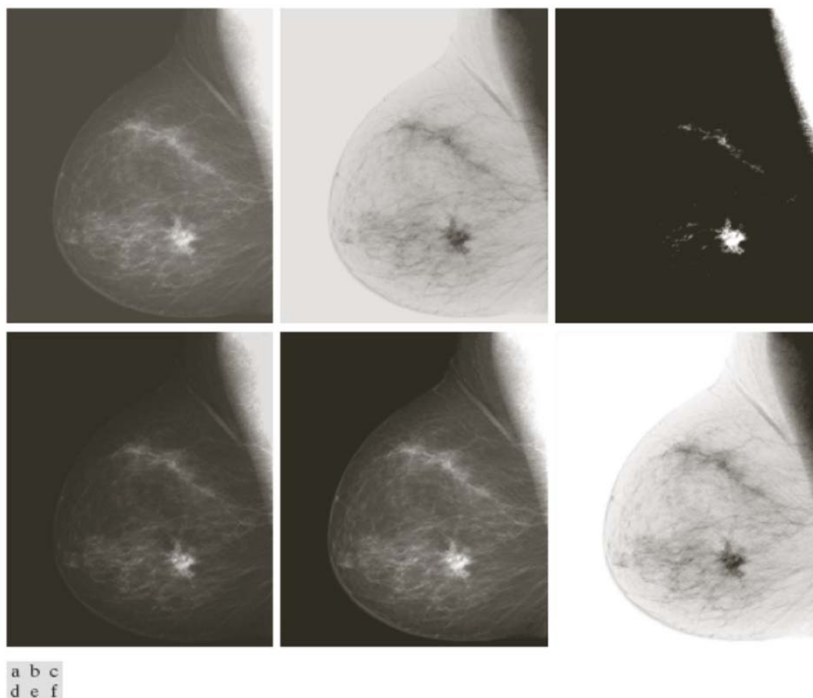
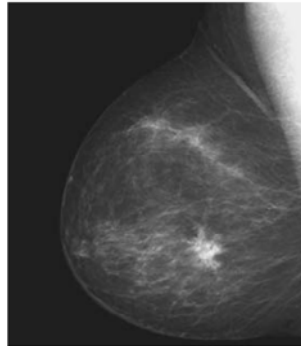


FIGURE 2.3 (a) Original digital mammogram. (b) Negative image. (c) Result of expanding the intensities in the range [0.5, 0.75]. (d) Result of enhancing the image with $\gamma = 2$. (e) and (f) Results of using function `stretchlim` as an automatic input into function `imadjust`. (Original image courtesy of G. E. Medical Systems.)

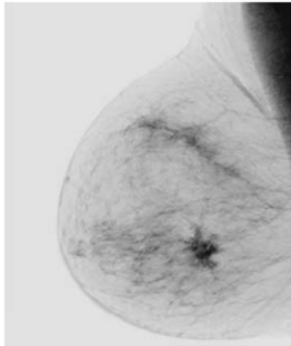
توابع تبدیل شدت رنگ

تابع تنظیم تصویر: مثال

f



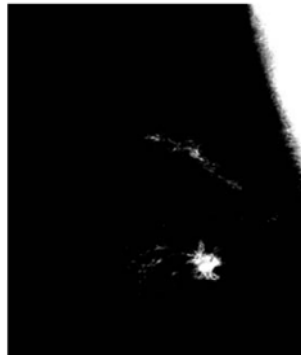
g1 = imadjust(f, [0 1], [1 0])



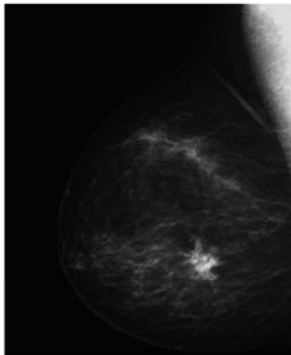
g = imcomplement(f)

a	b
c	d

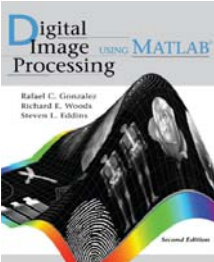
(b) Negative image. (c) Result of expanding the intensity range [0.5, 0.75]. (d) Result of enhancing the image with gamma = 2.



g2 = imadjust(f, [0.5 0.75], [0 1])

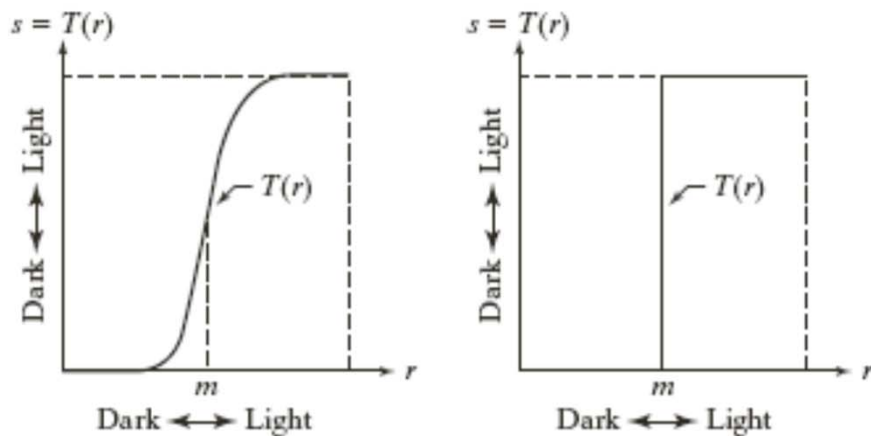


g2 = imadjust(f, [], [], 2)



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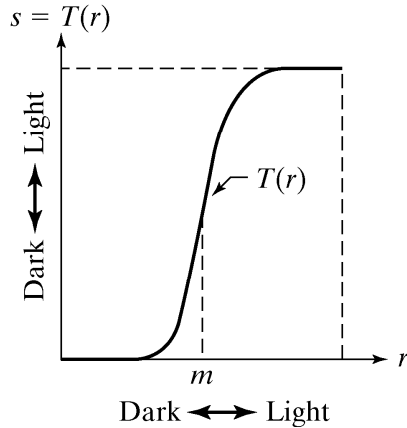
a b

FIGURE 2.4

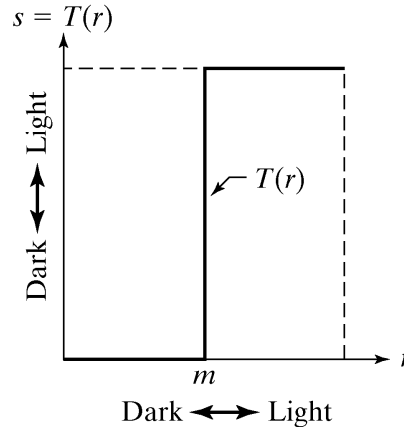
(a) Contrast-stretching transformation.
(b) Thresholding transformation.

توابع تبدیل شدت رنگ

تبدیل‌های کشش کنتراست و آستانه‌گیری

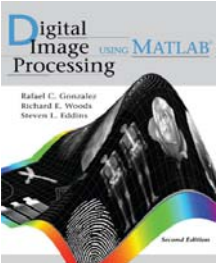


$$s = T(r) = \frac{1}{1 + (m/r)^E}$$



a b

(a) Contrast-stretching transformation.
(b) Thresholding transformation.



Chapter 3

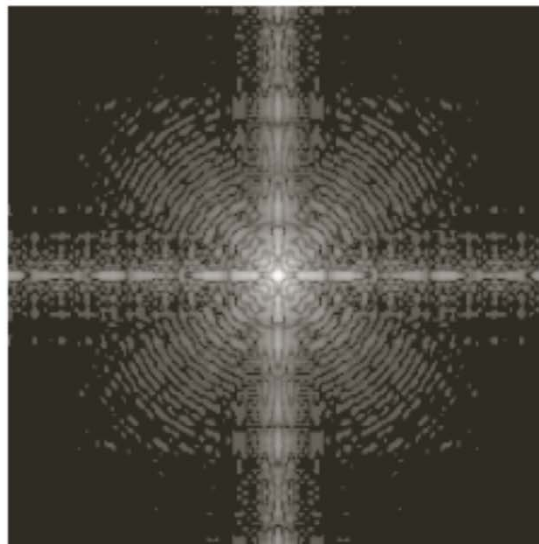
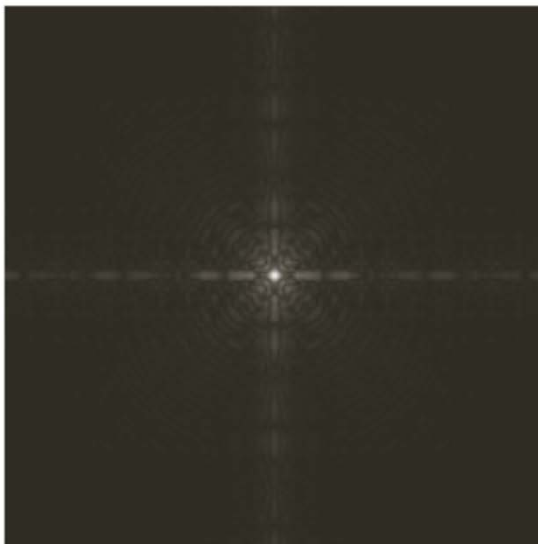
Intensity Transformations and Spatial Filtering

a b

FIGURE 2.5

(a) A Fourier spectrum.

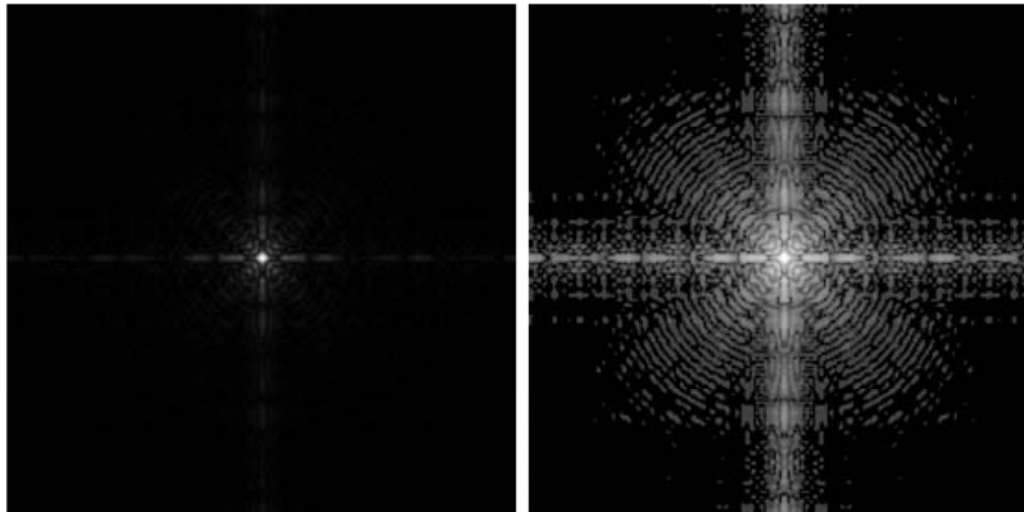
(b) Result of using a log transformation.



توابع تبدیل شدت رنگ

تبدیل لگاریتمی: استفاده از تبدیل لگاریتمی برای کاهش بازه‌ی پویای تصویر

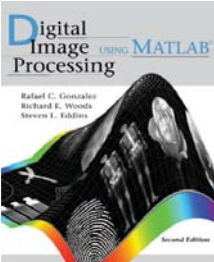
$$g = c * \log(1 + f)$$



a b

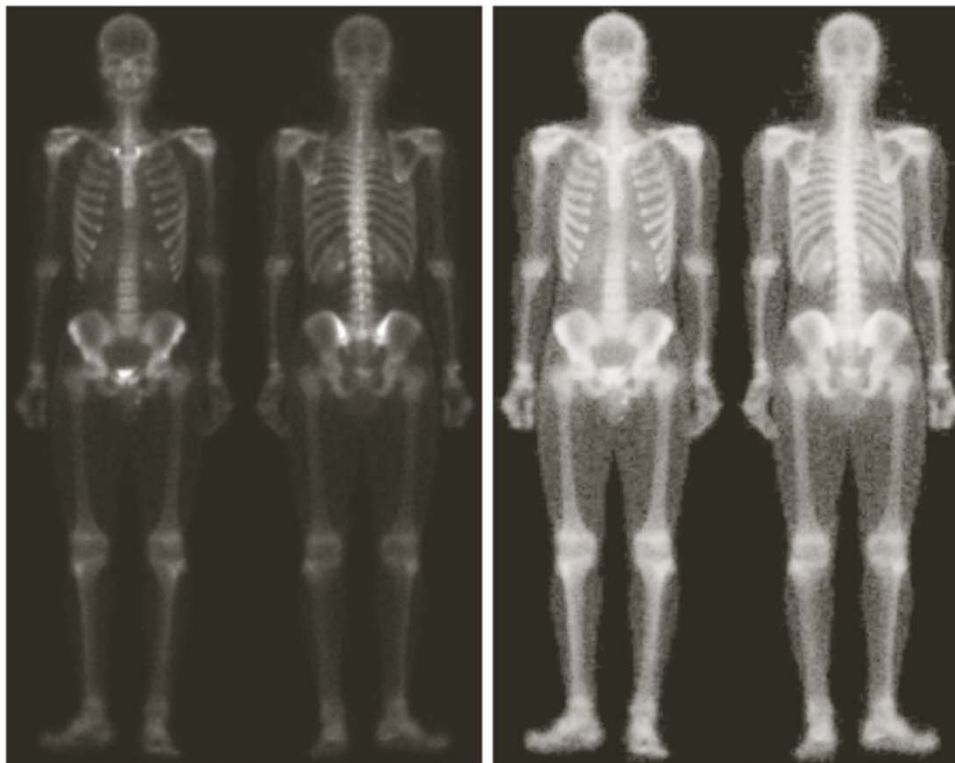
(a) A
Fourier spectrum.
(b) Result
obtained by
performing a log
transformation.

```
g = im2uint8(mat2gray(log(1 + double(f))))
```



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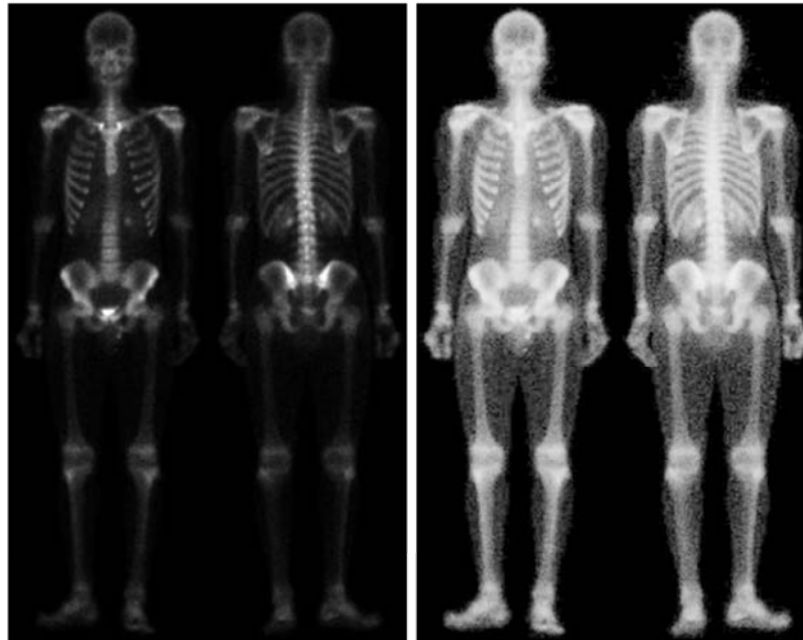
a b

FIGURE 2.6

(a) Bone scan image. (b) Image enhanced using a contrast-stretching transformation. (Original image courtesy of G. E. Medical Systems.)

توابع تبدیل شدت رنگ

کشش کنتراست

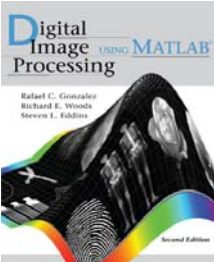


a b

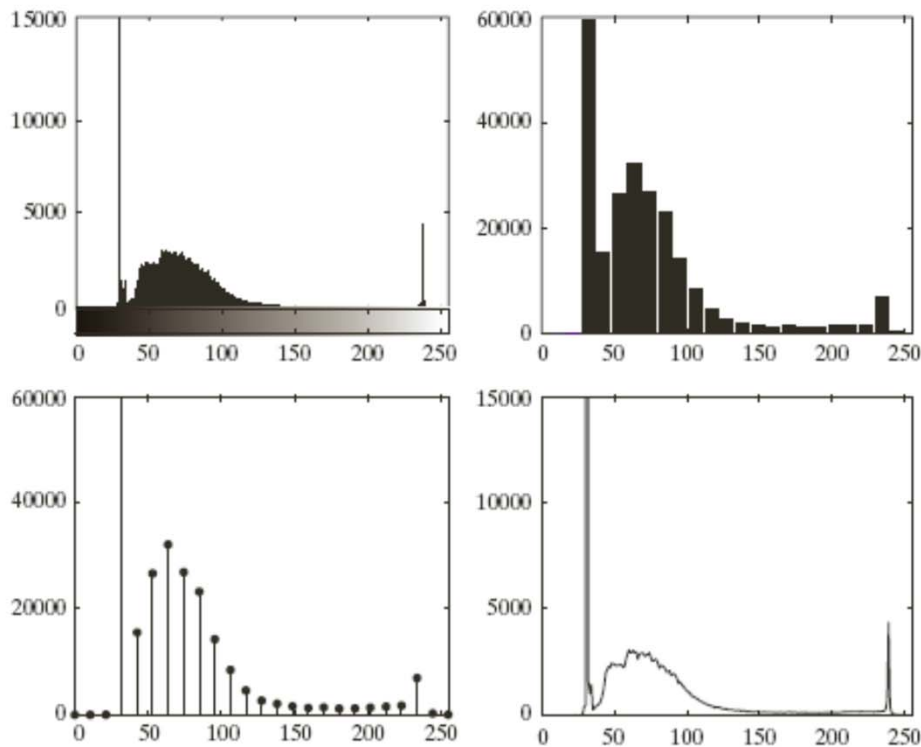
(a)

Bone scan image.

(b) Image enhanced using a contrast-stretching transformation.
(Original image



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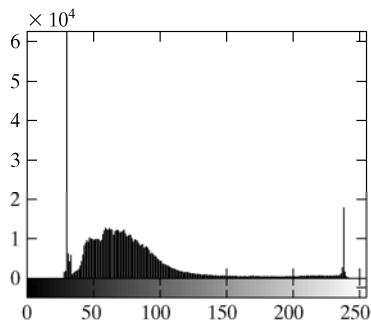
a b
c d

FIGURE 2.7 Various ways to plot an image histogram. (a) `imhist`, (b) `bar`, (c) `stem`, (d) `plot`.

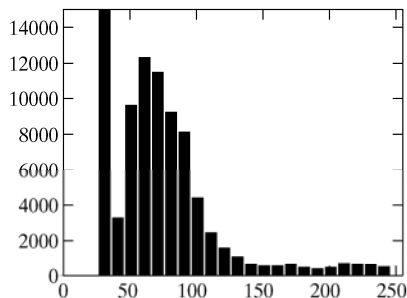
هیستوگرام تصویر

راههای ممکن برای رسم هیستوگرام تصویر

```
h = imhist(f)
```

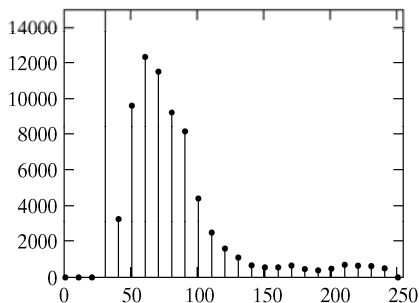


```
bar(horz, z, width)
```

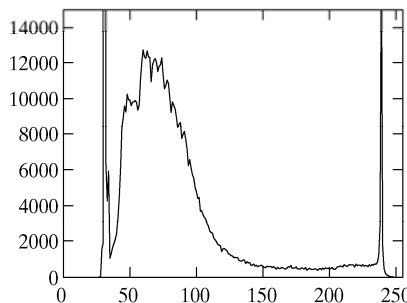


a b
c d

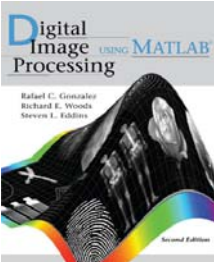
Various ways to plot an image histogram.
(a) imhist,
(b) bar,
(c) stem,
(d) plot.



```
stem(horz, z, 'LineStyle', 'fill')
```



```
plot(horz, z, 'LineStyle')
```



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Color Specifiers		Line Specifiers		Marker Specifiers	
Symbol	Color	Symbol	Line Style	Symbol	Marker
k	Black	-	Solid	+	Plus sign
w	White	--	Dashed	o	Circle
r	Red	:	Dotted	*	Asterisk
g	Green	-.	Dash-dot	.	Point
b	Blue			x	Cross
c	Cyan			s	Square
y	Yellow			d	Diamond
m	Magenta			^	Upward-pointing triangle
				v	Downward-pointing triangle
				>	Right-pointing triangle
				<	Left-pointing triangle
				p	Pentagram (five-point star)
				h	Hexagram (six-point star)

TABLE 2.1

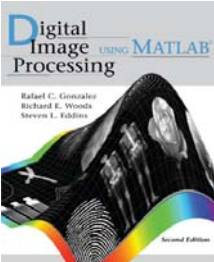
Color, line, and marker specifiers for use in functions `stem` and `plot`.

هیستوگرام تصویر

خصیصه‌های LineSpec

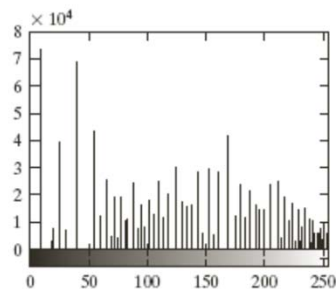
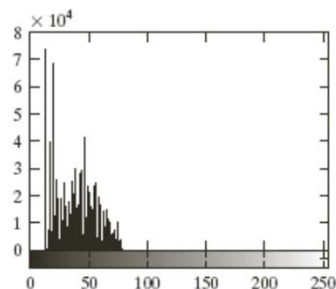
Symbol	Color	Symbol	Line Style	Symbol	Marker
k	Black	—	Solid	+	Plus sign
w	White	--	Dashed	o	Circle
r	Red	:	Dotted	*	Asterisk
g	Green	-.	Dash-dot	.	Point
b	Blue	none	No line	x	Cross
c	Cyan			s	Square
y	Yellow			d	Diamond
m	Magenta			none	No marker

Attributes for functions `stem` and `plot`. The `none` attribute is applicable only to function `plot`, and must be specified individually. See the syntax for function `plot` below.



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a b
c d

FIGURE 2.8

Illustration of histogram equalization.

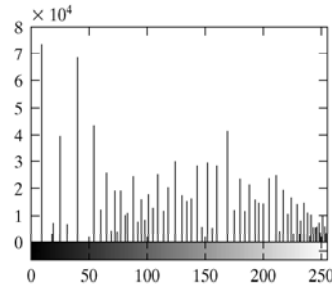
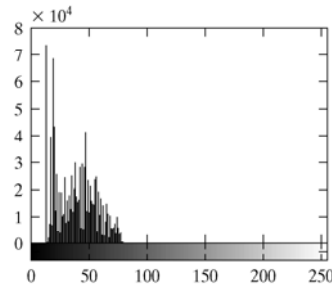
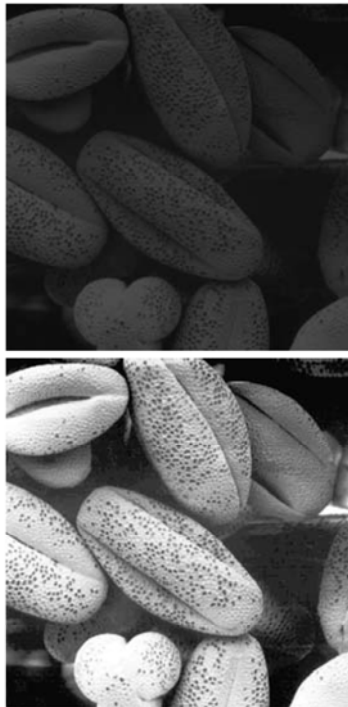
(a) Input image, and (b) its histogram.

(c) Histogram-equalized image, and (d) its histogram. The improvement between (a) and (c) is evident.

(Original image courtesy of Dr. Roger Heady, Research School of Biological Sciences, Australian National University, Canberra.)

هیستوگرام تصویر

تعدیل هیستوگرام



a b
c d

Illustration of
histogram
equalization.

(a) Input image,
and (b) its
histogram.

(c) Histogram-
equalized image,
and (d) its
histogram. The
improvement

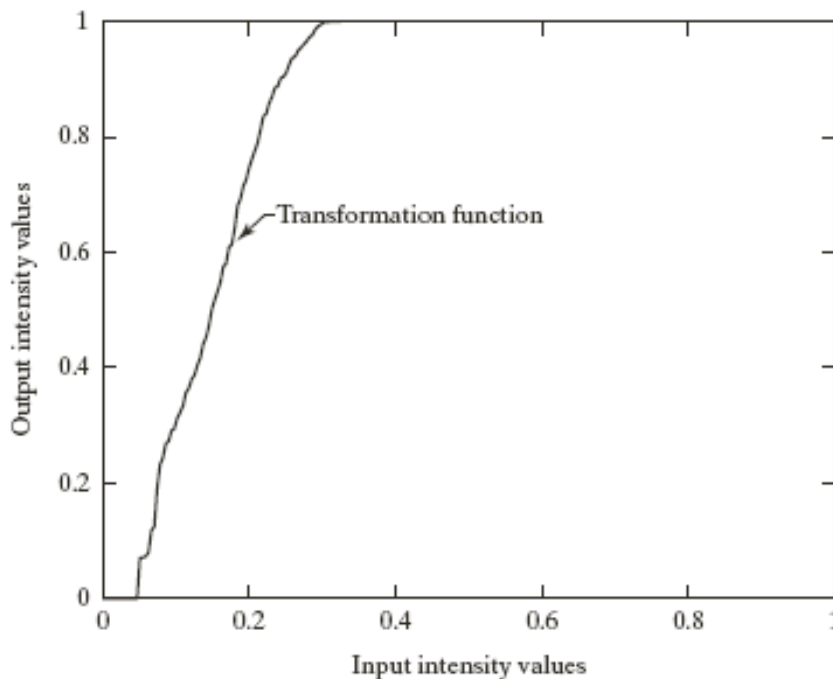
between (a) and
(c) is quite visible.

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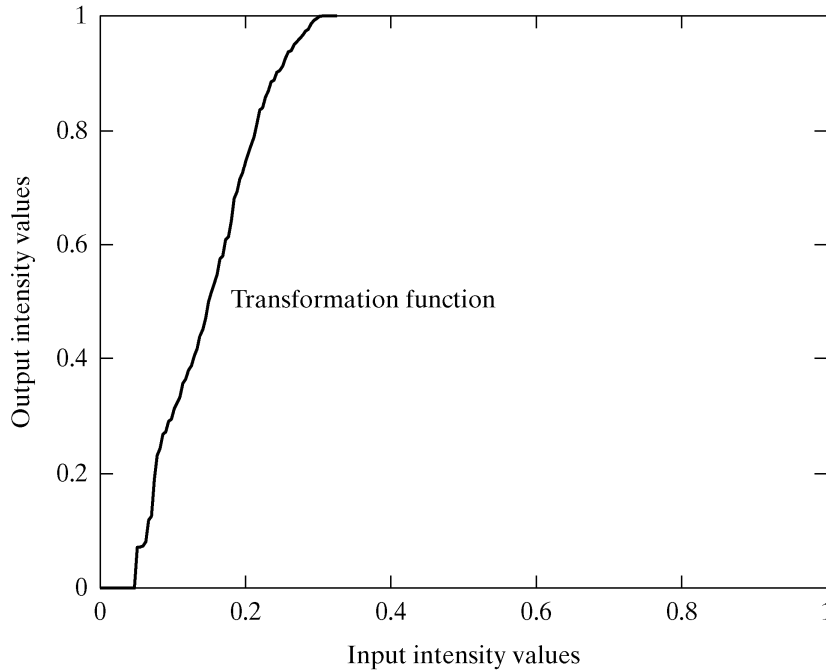
FIGURE 2.9

Transformation function used to map the intensity values from the input image in Fig. 2.7(a) to the values of the output image in Fig. 2.7(c).



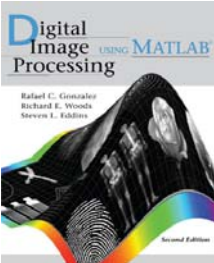
هستوگرام تصویر

تعدیل هستوگرام: تابع تبدیل



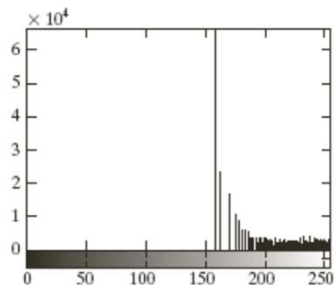
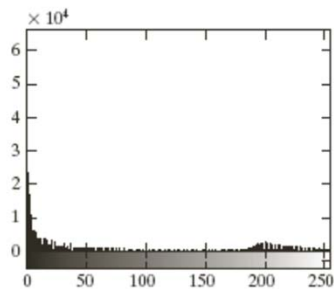
Transformation
function used to
map the intensity
values

```
hnorm = imhist(f) ./ numel(f); % Normalized histogram
cdf = cumsum(hnorm); % CDF
plot([0:256], cdf)
```



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a b
c d

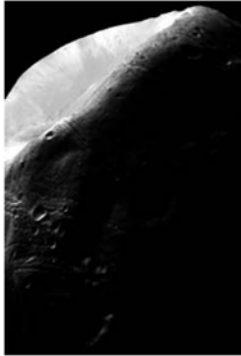
FIGURE 2.10

(a) Image of the Mars moon Phobos.
(b) Histogram.
(c) Histogram-equalized image.
(d) Histogram of (c).
(Original image courtesy of NASA.)

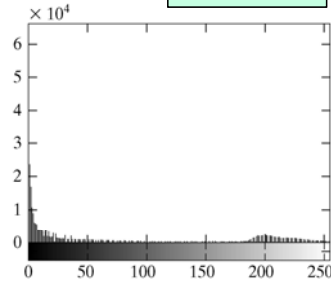
هیستوگرام تصویر

مثال: تعدیل هیستوگرام

f

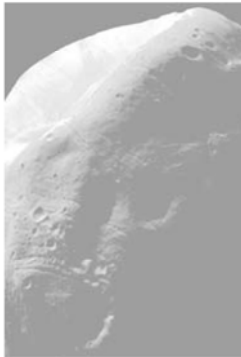


imhist(f)

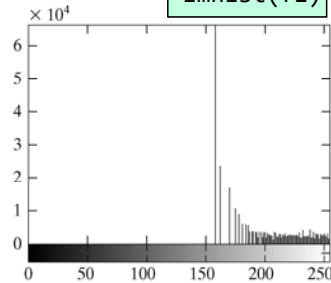
a b
c d

(a) Image of the Mars moon Phobos.
(b) Histogram.
(c) Histogram-equalized image.
(d) Histogram of (c).

f1 = histeq(f, 256)

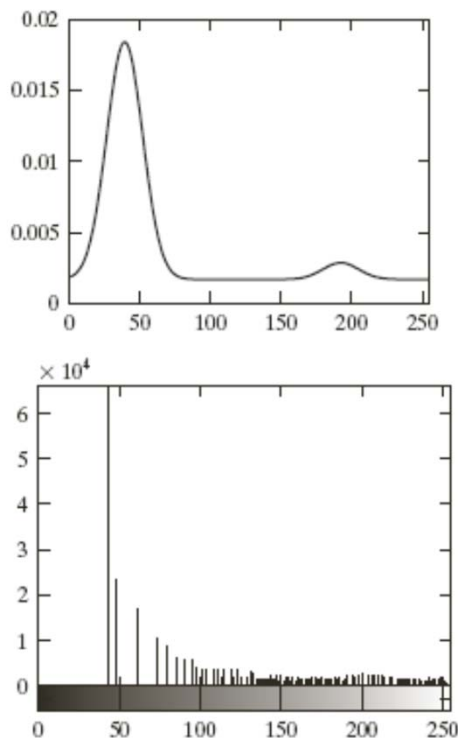


imhist(f1)



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a b
c

FIGURE 2.11

(a) Specified histogram.

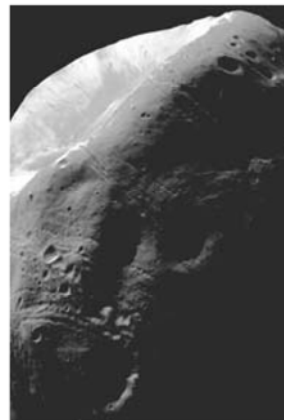
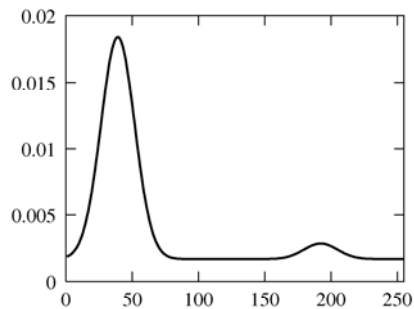
(b) Result of enhancement by histogram matching.

(c) Histogram of (b).

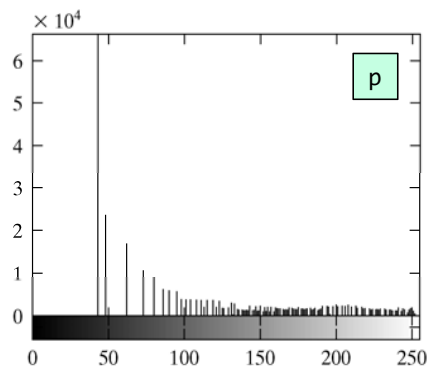
هیستوگرام تصویر

تطبیق هیستوگرام

هیستوگرام دلخواه

a b
c

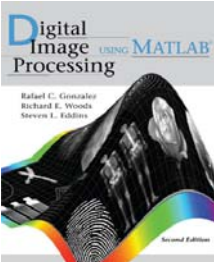
(a) Specified histogram.
(b) Result of enhancement by histogram matching.
(c) Histogram of (b).

 $g = \text{histeq}(f, p)$ 

هیستوگرام تصویر

تعدیل هیستوگرام افقی

$$g = \text{adapthisteq}(f, \dots)$$
$$g = \text{adapthisteq}(f)$$



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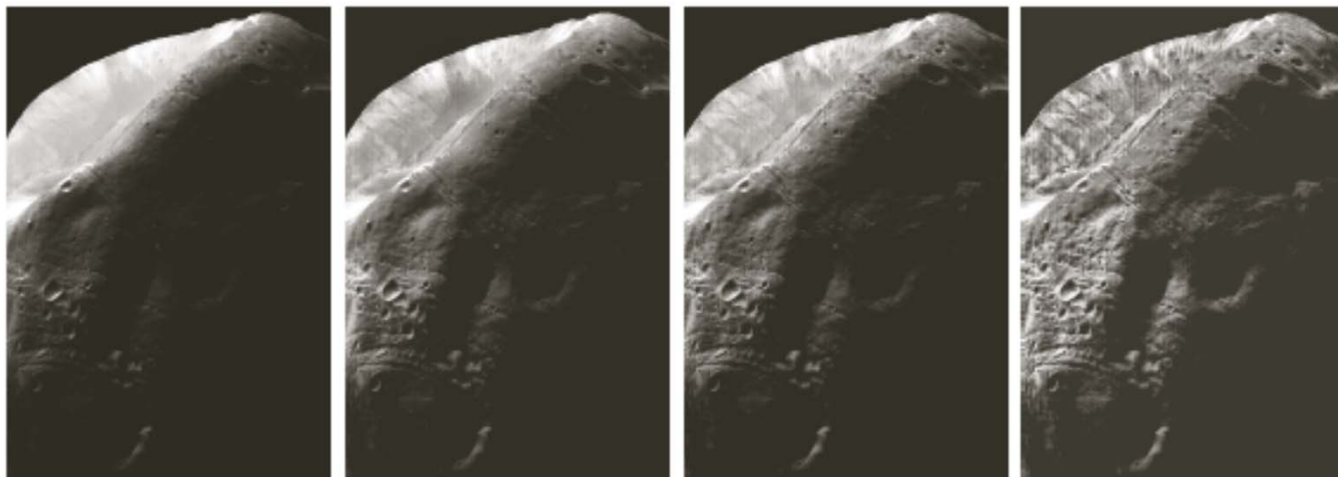
Intensity Transformations and Spatial Filtering

TABLE 2.2 Parameters and corresponding values for use in function `adapthisteq`.

Parameter	Value
'NumTiles'	Two-element vector of positive integers specifying the number of tiles by row and column, $[r \ c]$. Both r and c must be at least 2. The total number of tiles is equal to $r*c$. The default is $[8 \ 8]$.
'ClipLimit'	Scalar in the range $[0 \ 1]$ that specifies a contrast enhancement limit. Higher numbers result in more contrast. The default is 0.01.
'NBins'	Positive integer scalar specifying the number of bins for the histogram used in building a contrast enhancing transformation. Higher values result in greater dynamic range at the cost of slower processing speed. The default is 256.
'Range'	A string specifying the range of the output image data: 'original' — Range is limited to the range of the original image, $[\min(f(:)) \ \max(f(:))]$. 'full' — Full range of the output image class is used. For example, for <code>uint8</code> data, range is $[0 \ 255]$. This is the default.
'Distribution'	A string specifying the desired histogram shape for the image tiles: 'uniform' — Flat histogram (this is the default). 'rayleigh' — Bell-shaped histogram. 'exponential' — Curved histogram. (See Section 4.2.2 for the equations for these distributions.)
'Alpha'	Nonnegative scalar applicable to the Rayleigh and exponential distributions. The default value is 0.4.

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a b c d

FIGURE 2.12 (a) Same as Fig. 2.10(a). (b) Result of using function `adapthisteq` with the default values. (c) Result of using this function with parameter `NumTiles` set to [25 25]. Result of using this number of tiles and `ClipLimit` = 0.05.

هستوگرام تصویر

تعدیل هستوگرام افقی: مثال



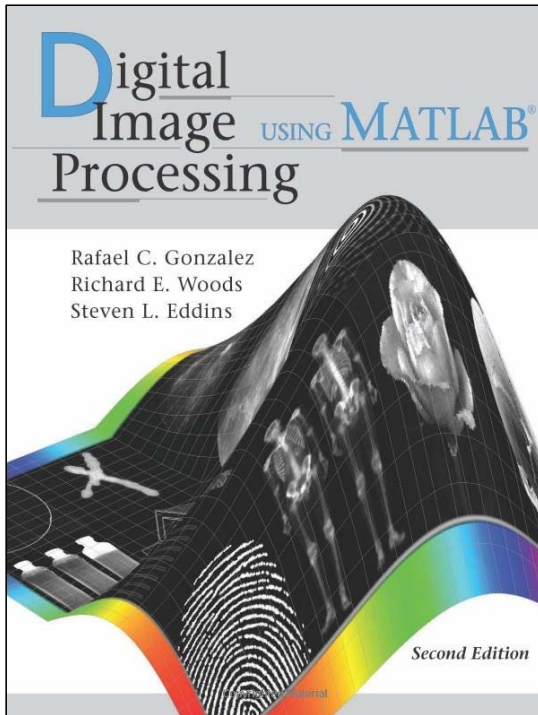
f



g = adapthisteq(f)

g = adapthisteq(f,
'NumTiles', [25 25])g = adapthisteq(f,
'NumTiles', [25 25],
'ClipLimit', 0.05)

منبع اصلی



Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins,
Digital Image Processing Using MATLAB[®],
Second Edition, Pearson Prentice Hall, 2008.
Chapter 3 (3-1 .. 3-3)