

Digital Image Processing, 3rd ed.

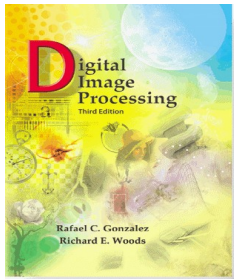
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Chapter 1

Introduction

Tópicos em Informática



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Chapter 1

Introduction

OBJETIVOS GERAIS: Proporcionar aos alunos os conhecimentos fundamentais sobre o processamento de imagens digitais

TÓPICOS

Introdução ao processamento digital de imagens

Percepção visual e fundamentos sobre imagens digitais

Melhoramento de imagens no domínio espacial

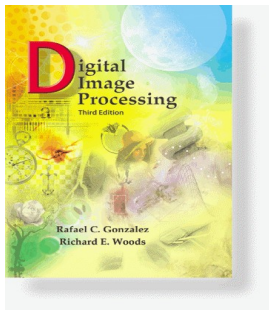
Melhoramento de imagens no domínio espectral

Restauração de imagens

Segmentação de imagens

Representação e descrição de imagens

Reconhecimento e interpretação de imagens



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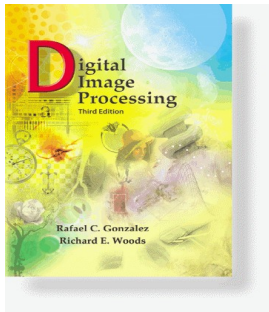
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• BIBLIOGRAFIA

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2. Gonzalez, R.C. & Woods, R.E. - Processamento de Imagens Digitais (tradução). São Paulo, Edgard Blucher Ltda, 2000.
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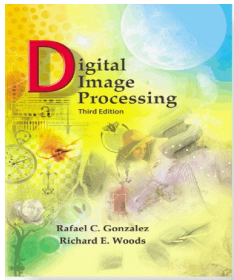
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- The book web site:

www.prenhall.com/gonzalezwoods

www.imageprocessingplace.com

Contem revisões, soluções de problemas, projetos, tutoriais e banco de dados de imagens.



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Avaliação:

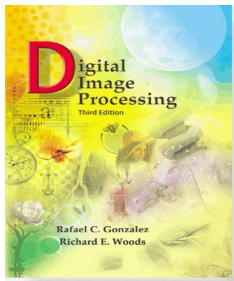
2 provas: P1 (meio do semestre)

P2 (fim do semestre)

EX – exercícios, devem ser entregues no prazo (fora de prazo atinge apenas a nota mínima de aprovação = 6.0)

$$\text{NOTA FINAL} = 0,35 \times P1 + 0,35 \times P2 + 0,3 \times EX$$

Prova substitutiva substitui P1 ou P2.



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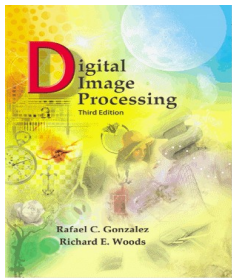
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- A origem de Processamento de Imagens Digitais: indústria de jornais transportando imagens usando cabo submarino de Londres a Nova York.



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FIGURE 1.1 A digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces. (McFarlane.[†])

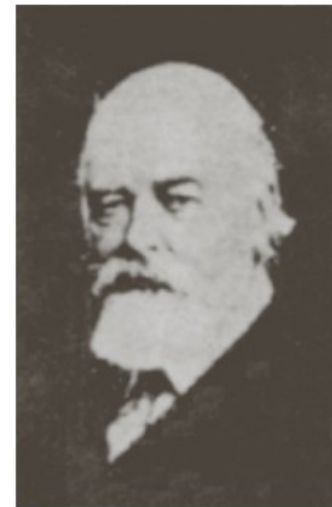
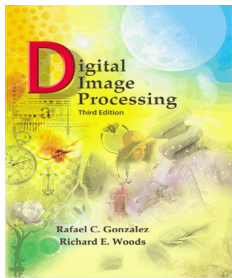


FIGURE 1.2 A digital picture made in 1922 from a tape punched after the signals had crossed the Atlantic twice. (McFarlane.)

Uma imagem digital produzida em 1921 de uma fita codificada usando impressora telegráfica com tipos especiais

Uma imagem digital feita em 1922 de uma fita perfurada após os sinais terem cruzado o Atlântico duas vezes



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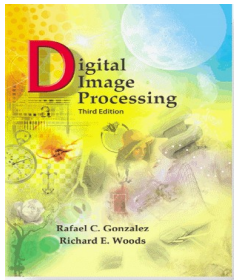
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FIGURE 1.3
Unretouched
cable picture of
Generals Pershing
and Foch,
transmitted in
1929 from
London to New
York by 15-tone
equipment.
(McFarlane.)

Imagem sem retoque de
generais Pershing e Foch,
transmitidos em 1929 de
Londres a Nova York por
um equipamento de 15 ton's.



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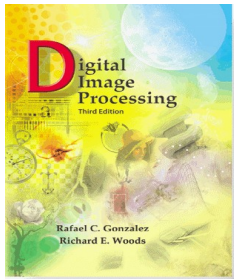
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FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9 : 09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

Primeira imagem
da Lua por uma nave
espacial americana.
Ranger 7 captou essa
imagem em 31/07/1964
aproximadamente 17 min.
antes do impacto com a
superfície lunar.



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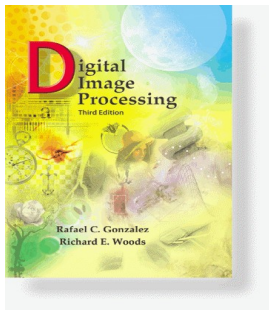
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- Principais exemplos de aplicações de processamento de imagens digitais:
 - Imagens baseadas em radiação (espectro eletromagnético)
 - Imagens baseadas em energias acústicas, ultrasônicas, e eletrônicas
 - Imagens sintéticas usadas para modelamento e visualização, geradas por computador.



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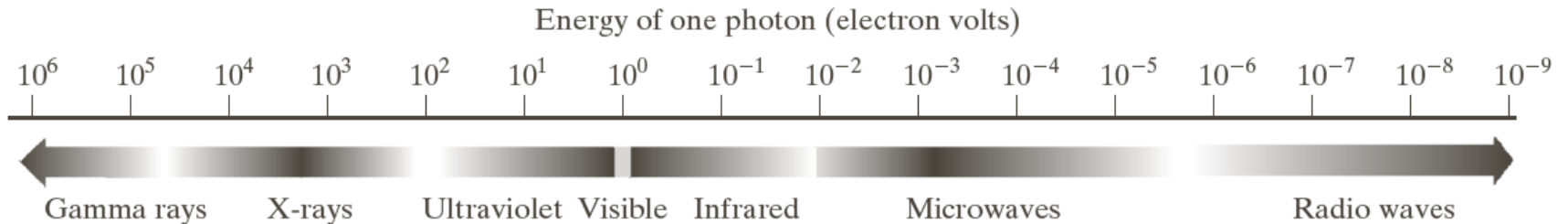
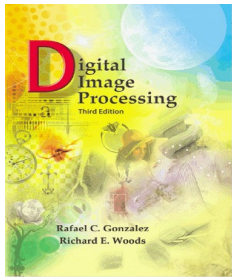


FIGURE 1.5 The electromagnetic spectrum arranged according to energy per photon.

Espectro eletromagnético de acordo com a energia por fóton

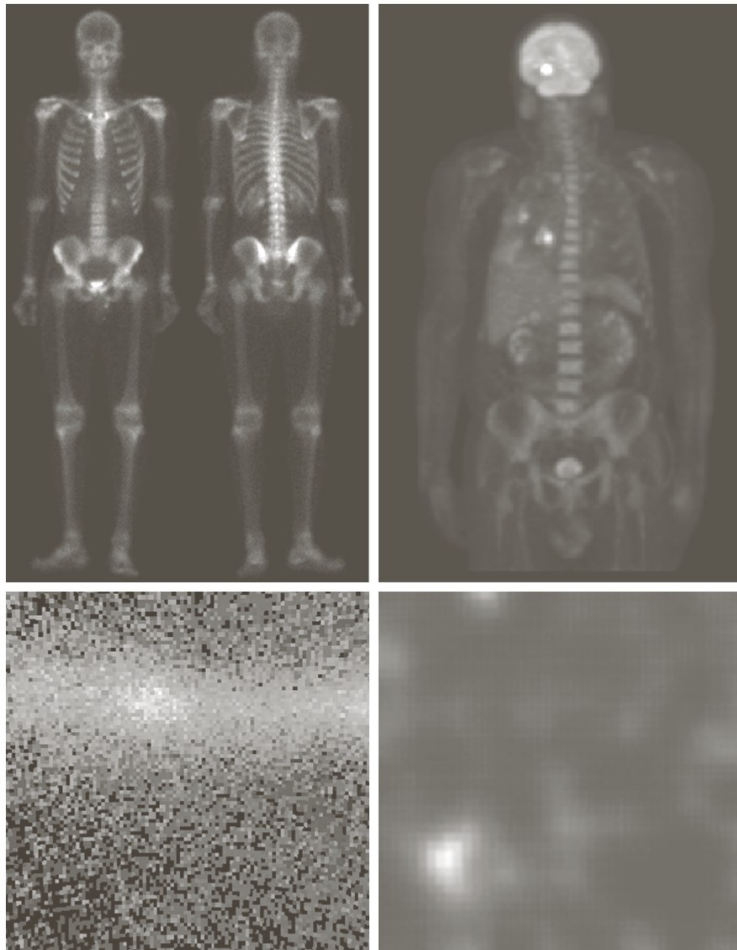


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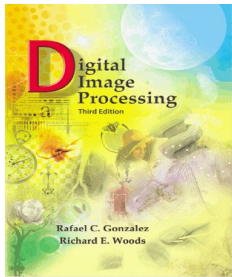
a b
c d

FIGURE 1.6

Examples of gamma-ray imaging. (a) Bone scan. (b) PET image. (c) Cygnus Loop. (d) Gamma radiation (bright spot) from a reactor valve. (Images courtesy of (a) G.E. Medical Systems, (b) Dr. Michael E. Casey, CTI PET Systems, (c) NASA, (d) Professors Zhong He and David K. Wehe, University of Michigan.)

Exemplos de imagens de raios-gamma:

(a) “escaneamento” do esqueleto,
(b) imagem PET,
(c) constelação de Cygnus, e
(d) radiação Gamma
(mancha brilhante) de uma válvula
de reator.

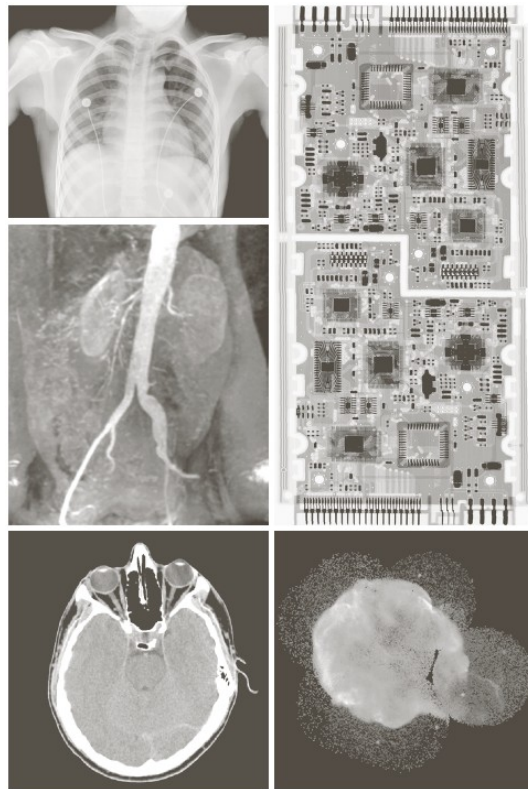


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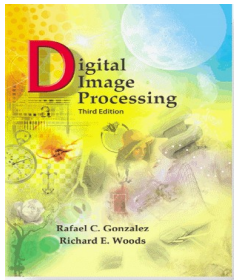
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Exemplos de imagens
de raios-X:
(a) do tórax,
(b) angiograma aórtica,
(c) TC da cabeça,
(d) cartões de circuitos, e
(e) constelação de Cygnus.

FIGURE 1.7 Examples of X-ray imaging. (a) Chest X-ray. (b) Aortic angiogram. (c) Head CT. (d) Circuit boards. (e) Cygnus Loop. (Images courtesy of (a) and (c) Dr. David R. Pickens, Dept. of Radiology & Radiological Sciences, Vanderbilt University Medical Center; (b) Dr. Thomas R. Gest, Division of Anatomical Sciences, University of Michigan Medical School; (d) Mr. Joseph E. Pascente, Lixi, Inc.; and (e) NASA.)

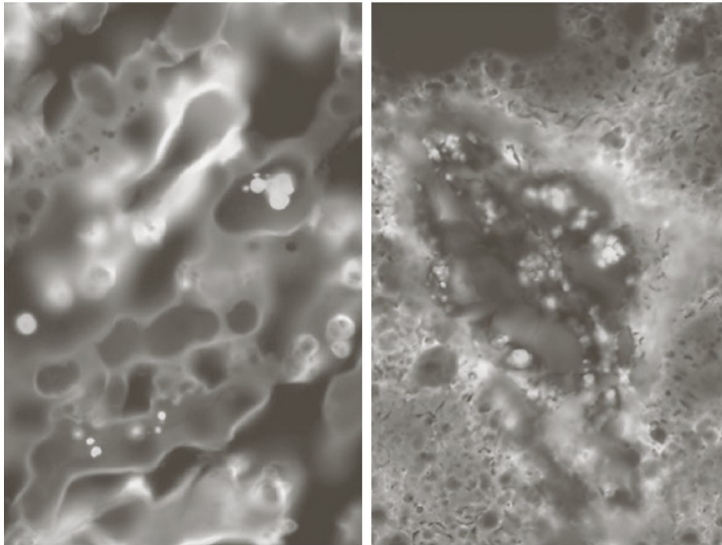


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a b
c

FIGURE 1.8

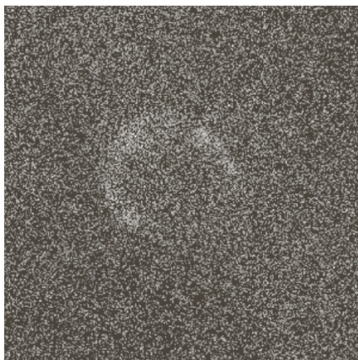
Examples of
ultraviolet
imaging.

(a) Normal corn.

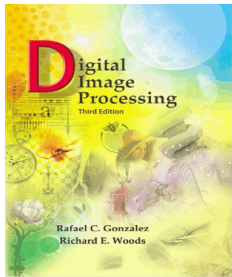
(b) Smut corn.

(c) Cygnus Loop.
(Images courtesy

of (a) and
(b) Dr. Michael
W. Davidson,
Florida State
University,
(c) NASA.)



Exemplos de imagens
ultravioleta:
(a) milho normal,
(b) milho infectado, e
(c) constelação de Cygnus.



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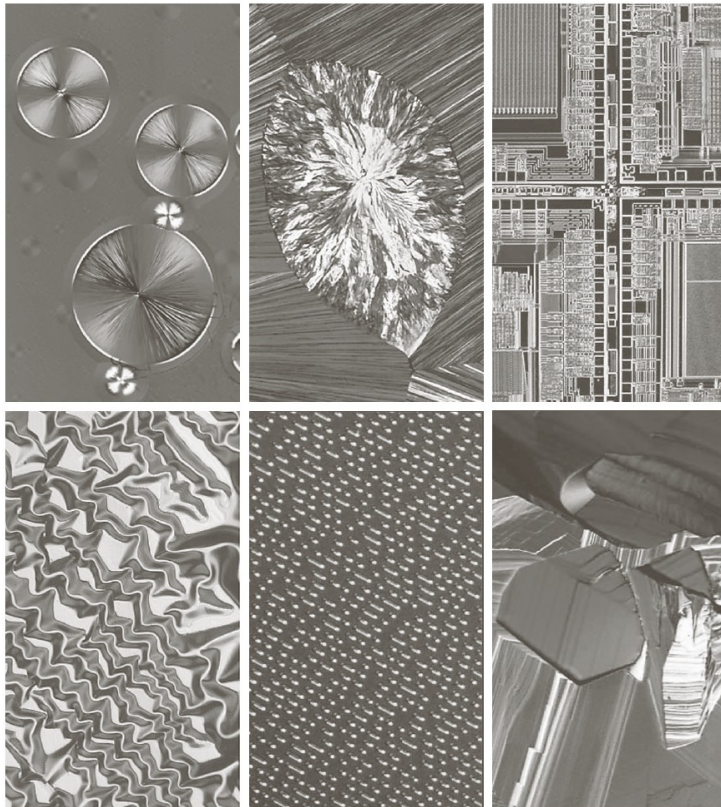
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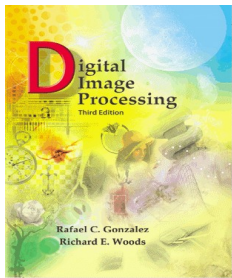
Exemplos de imagens microscópicas de luz:

- (a) taxol (agente anti-cancerígeno) aumentado 250x,
- (b) colesterol – 40x,
- (c) microprocessador - 60x,
- (d) filme fino de óxido de níquel – 600x,
- (e) superfície de CD de áudio – 1750x, e
- (f) semicondutor orgânico – 450x.



| | | |
|---|---|---|
| a | b | c |
| d | e | f |

FIGURE 1.9 Examples of light microscopy images. (a) Taxol (anticancer agent), magnified 250 \times . (b) Cholesterol—40 \times . (c) Microprocessor—60 \times . (d) Nickel oxide thin film—600 \times . (e) Surface of audio CD—1750 \times . (f) Organic superconductor—450 \times . (Images courtesy of Dr. Michael W. Davidson, Florida State University.)



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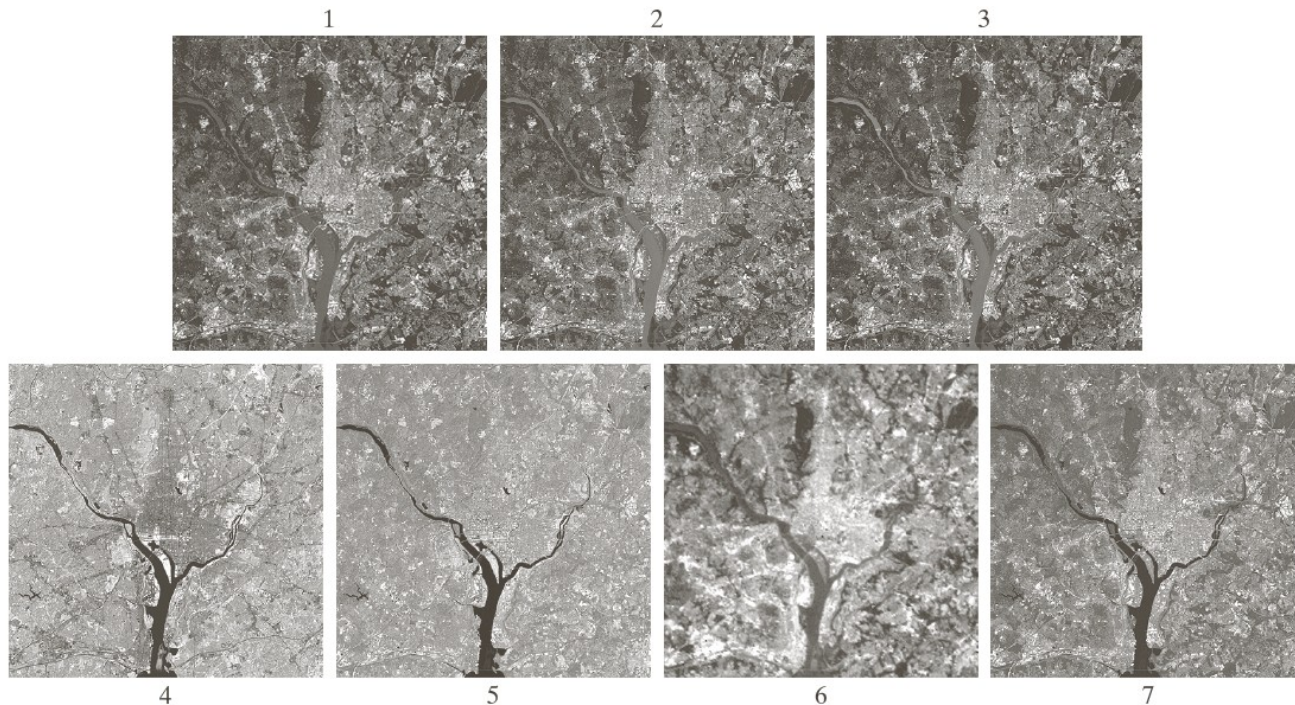
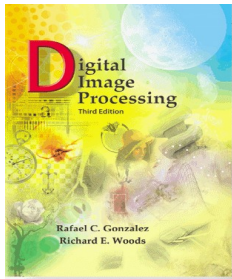


FIGURE 1.10 LANDSAT satellite images of the Washington, D.C. area. The numbers refer to the thematic bands in Table 1.1. (Images courtesy of NASA.)

Imagens do satélite LANDSAT da área de Washington D.C.



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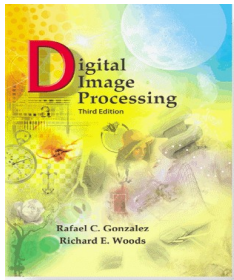
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TABLE 1.1

Thematic bands
in NASA's
LANDSAT
satellite.

| Band No. | Name | Wavelength (μm) | Characteristics and Uses |
|----------|------------------|------------------------------|---|
| 1 | Visible blue | 0.45–0.52 | Maximum water penetration |
| 2 | Visible green | 0.52–0.60 | Good for measuring plant vigor |
| 3 | Visible red | 0.63–0.69 | Vegetation discrimination |
| 4 | Near infrared | 0.76–0.90 | Biomass and shoreline mapping |
| 5 | Middle infrared | 1.55–1.75 | Moisture content of soil and vegetation |
| 6 | Thermal infrared | 10.4–12.5 | Soil moisture; thermal mapping |
| 7 | Middle infrared | 2.08–2.35 | Mineral mapping |

**Bandas
temáticas
do satélite
LANDSAT
da NASA.**



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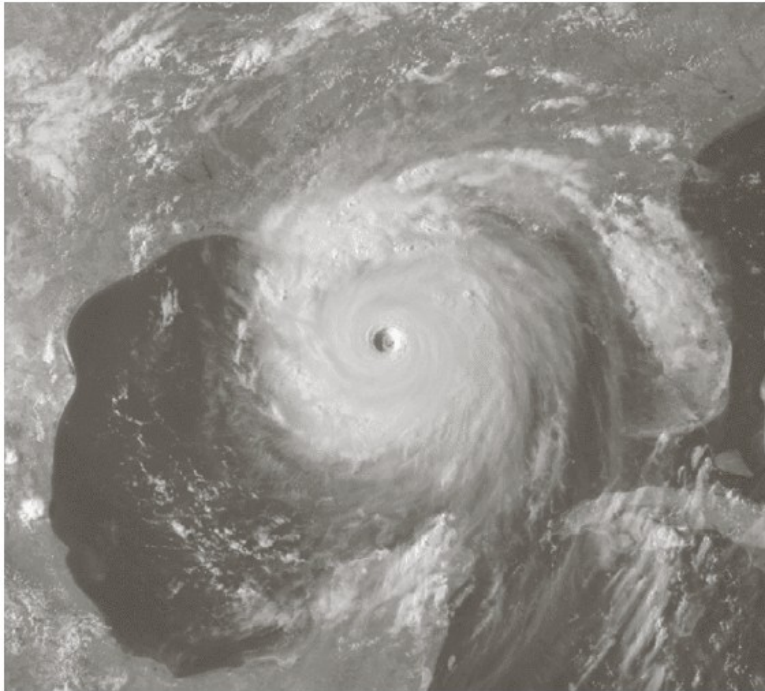
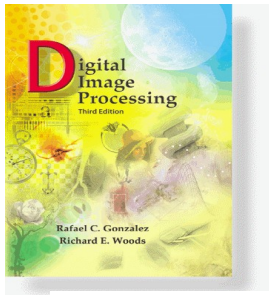


FIGURE 1.11
Satellite image
of Hurricane
Katrina taken on
August 29, 2005.
(Courtesy of
NOAA.)

Imagens de satélite
do furacão Katrina
captadas em 29 de
agosto de 2005.



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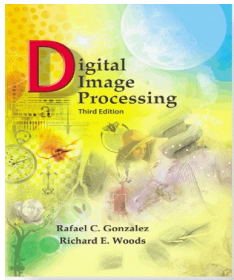
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FIGURE 1.12

Infrared satellite images of the Americas. The small gray map is provided for reference. (Courtesy of NOAA.)



Imagens de satélite,
infravermelho, das
Américas.



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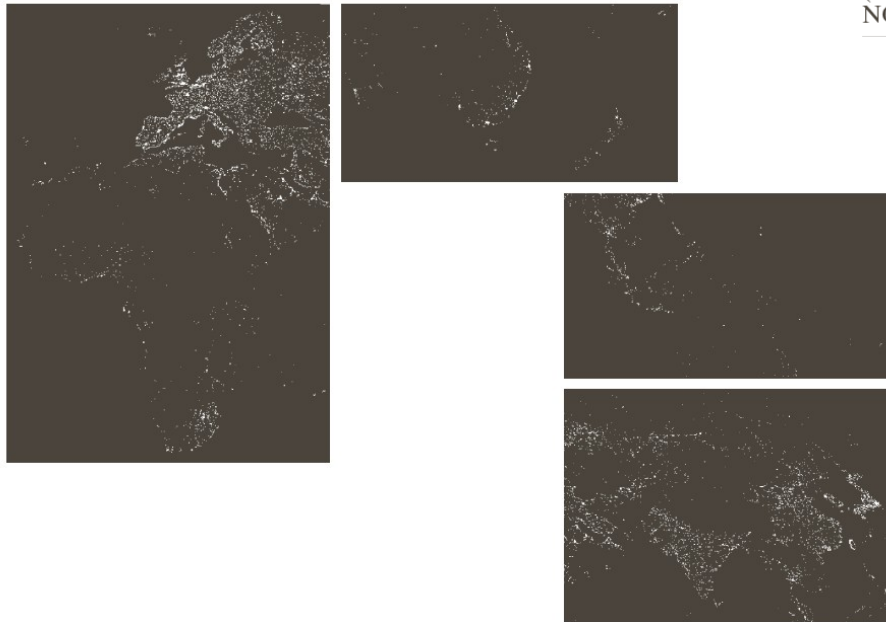
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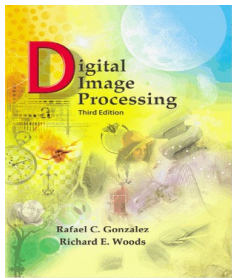


FIGURE 1.13

Infrared satellite images of the remaining populated part of the world. The small gray map is provided for reference. (Courtesy of NOAA.)



Imagens de satélite,
infravermelho, do
restante do mundo.

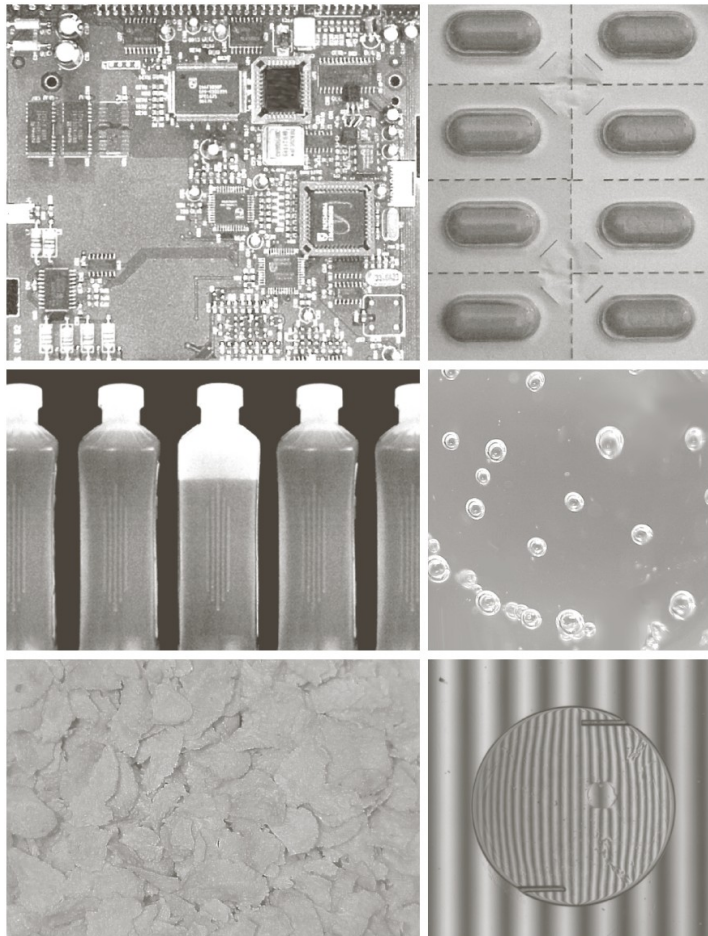


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a b
c d
e f

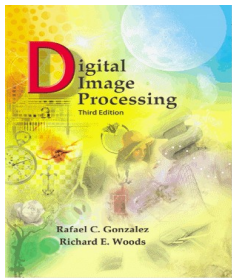
FIGURE 1.14

Some examples of manufactured goods often checked using digital image processing.

(a) A circuit board controller.
(b) Packaged pills.
(c) Bottles.
(d) Air bubbles in a clear-plastic product.
(e) Cereal.
(f) Image of intraocular implant.
(Fig. (f) courtesy of Mr. Pete Sites, Perceptics Corporation.)

Alguns exemplos de bens manufaturados normalmente supervisionados usando processamento de imagens:

- (a) circuito impresso,
- (b) pílulas,
- (c) garrafas,
- (d) bolhas de ar em produtos de plástico,
- (e) cereal, e
- (f) imagem de implante intra-ocular.



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a b
c
d

FIGURE 1.15

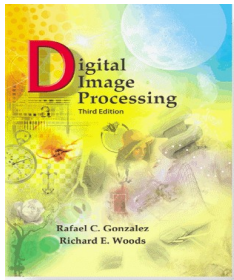
Some additional examples of imaging in the visual spectrum.

(a) Thumb print. (b) Paper currency. (c) and (d) Automated license plate reading.

(Figure (a) courtesy of the National Institute of Standards and Technology. Figures (c) and (d) courtesy of Dr. Juan Herrera, Perceptics Corporation.)

Alguns exemplos adicionais de imagens, no espectro visual:

(a) impressão digital,
(b) dinheiro,
(c) e (d) leitura automática de placas.



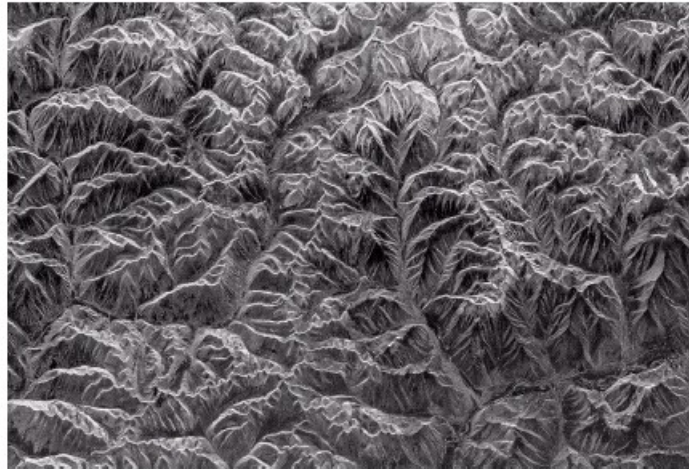
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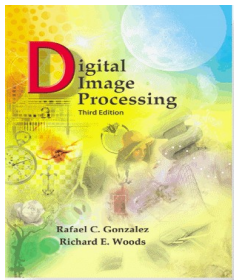
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FIGURE 1.16
Spaceborne radar
image of
mountains in
southeast Tibet.
(Courtesy of
NASA.)



Imagens de radar das
montanhas do sudeste
do Tibet, obtidas usando
nave espacial.

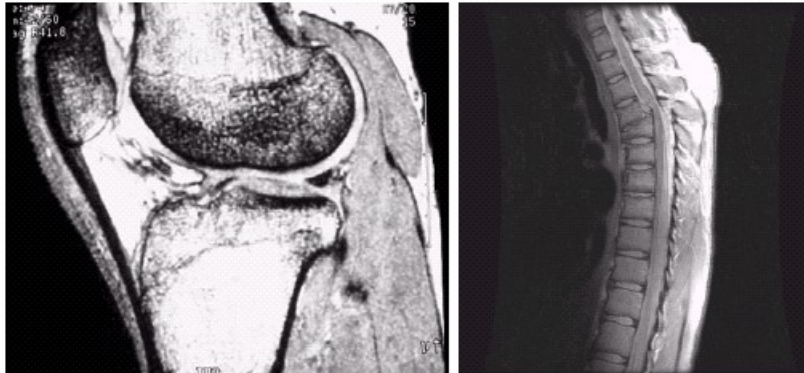


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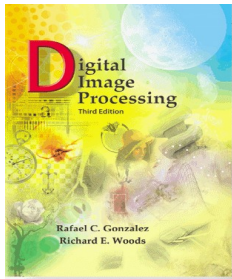
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a b

FIGURE 1.17 MRI images of a human (a) knee, and (b) spine. (Image (a) courtesy of Dr. Thomas R. Gest, Division of Anatomical Sciences, University of Michigan Medical School, and (b) Dr. David R. Pickens, Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center.)

Imagens MRI de um homem: (a) joelho e (b) espinha.



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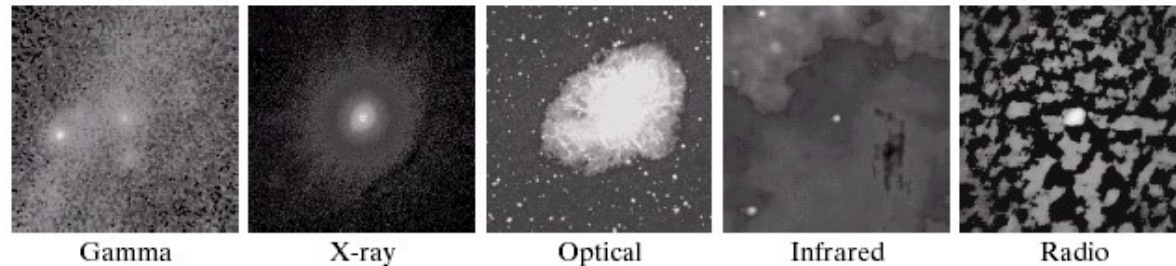
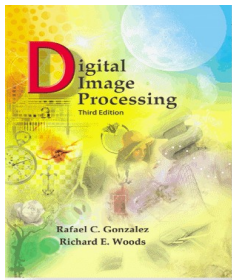


FIGURE 1.18 Images of the Crab Pulsar (in the center of images) covering the electromagnetic spectrum. (Courtesy of NASA.)

Imagens da constelação “ Pulsar”
cobrindo o espectro eletromagnético.



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FIGURE 1.19
Cross-sectional
image of a seismic
model. The arrow
points to a
hydrocarbon (oil
and/or gas) trap.
(Courtesy of
Dr. Curtis Ober,
Sandia National
Laboratories.)

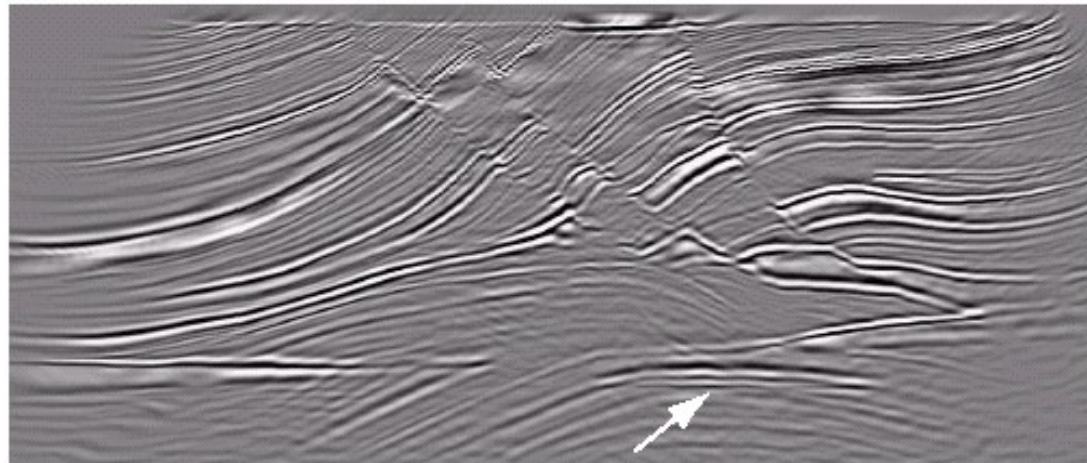
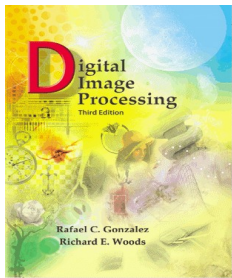


Imagem de secção de um modelo sísmico.
A flecha aponta a um hidrocarboneto (óleo e gás).

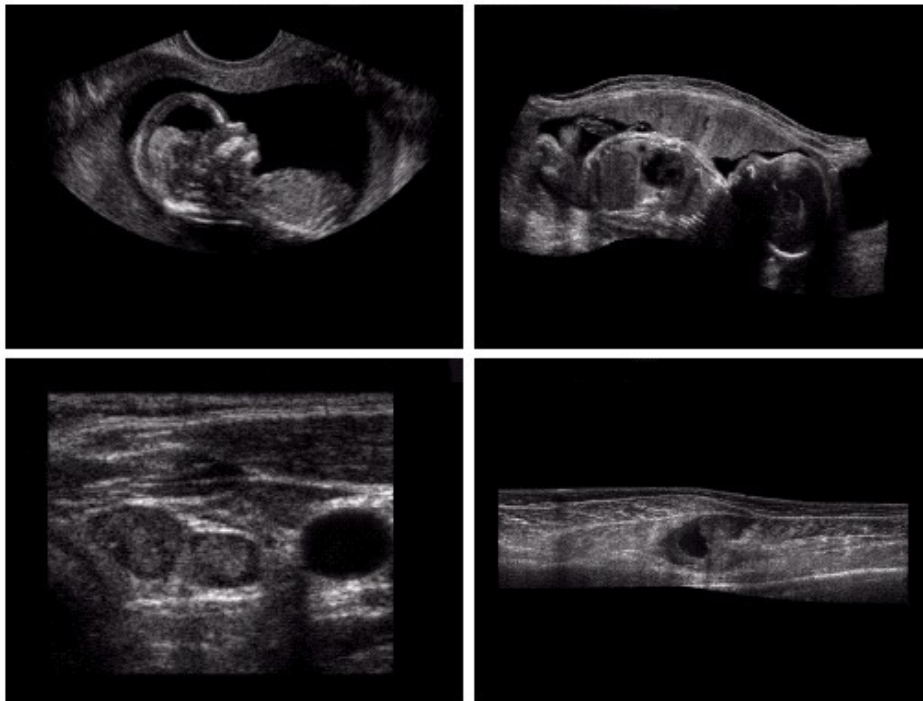


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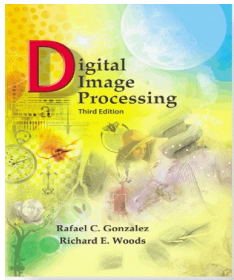
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a b
c d

FIGURE 1.20
Examples of
ultrasound
imaging. (a) Baby.
(2) Another view
of baby.
(c) Thyroids.
(d) Muscle layers
showing lesion.
(Courtesy of
Siemens Medical
Systems, Inc.,
Ultrasound
Group.)

Exemplos de imagens de
ultrasom. (a) feto; (b) outra
vista do feto; (c) tireóide;
(d) camada muscular mostrando
lesão.

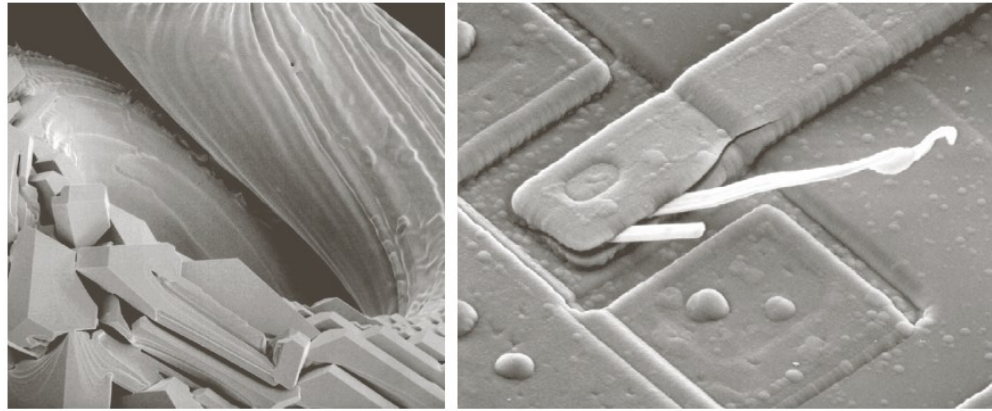


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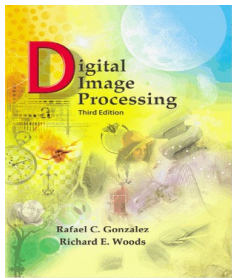


a b

FIGURE 1.21 (a) 250 \times SEM image of a tungsten filament following thermal failure (note the shattered pieces on the lower left). (b) 2500 \times SEM image of damaged integrated circuit. The white fibers are oxides resulting from thermal destruction. (Figure (a) courtesy of Mr. Michael Shaffer, Department of Geological Sciences, University of Oregon, Eugene; (b) courtesy of Dr. J. M. Hudak, McMaster University, Hamilton, Ontario, Canada.)

a) 250 x SEM (scanning electron microscope) de um filamento de tungstênio com falha térmica (ver pedaços na parte inferior).

b) 2500x SEM, imagem de um circuito integrado danificado. A fibra branca é resultado de óxidos da destruição térmica.

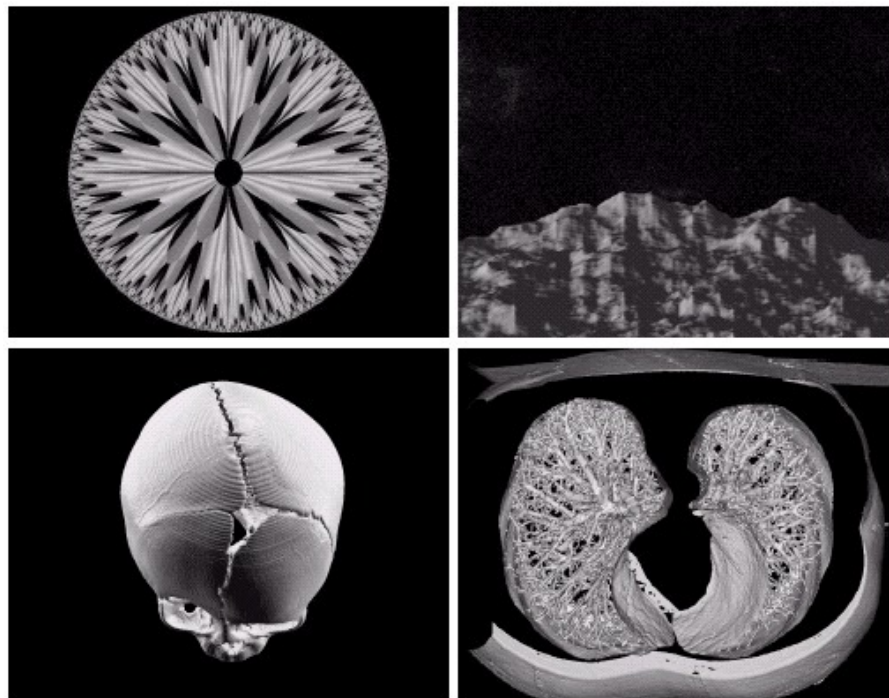


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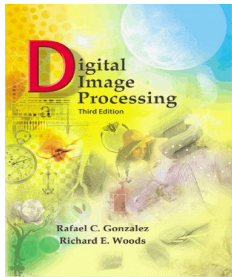
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a b
c d

FIGURE 1.22
(a) and (b) Fractal images. (c) and (d) Images generated from 3-D computer models of the objects shown. (Figures (a) and (b) courtesy of Ms. Melissa D. Binde, Swarthmore College, (c) and (d) courtesy of NASA.)

(a) e (b) são imagens fractais.
(c) e (d) são imagens geradas por computador.



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Outputs of these processes generally are images

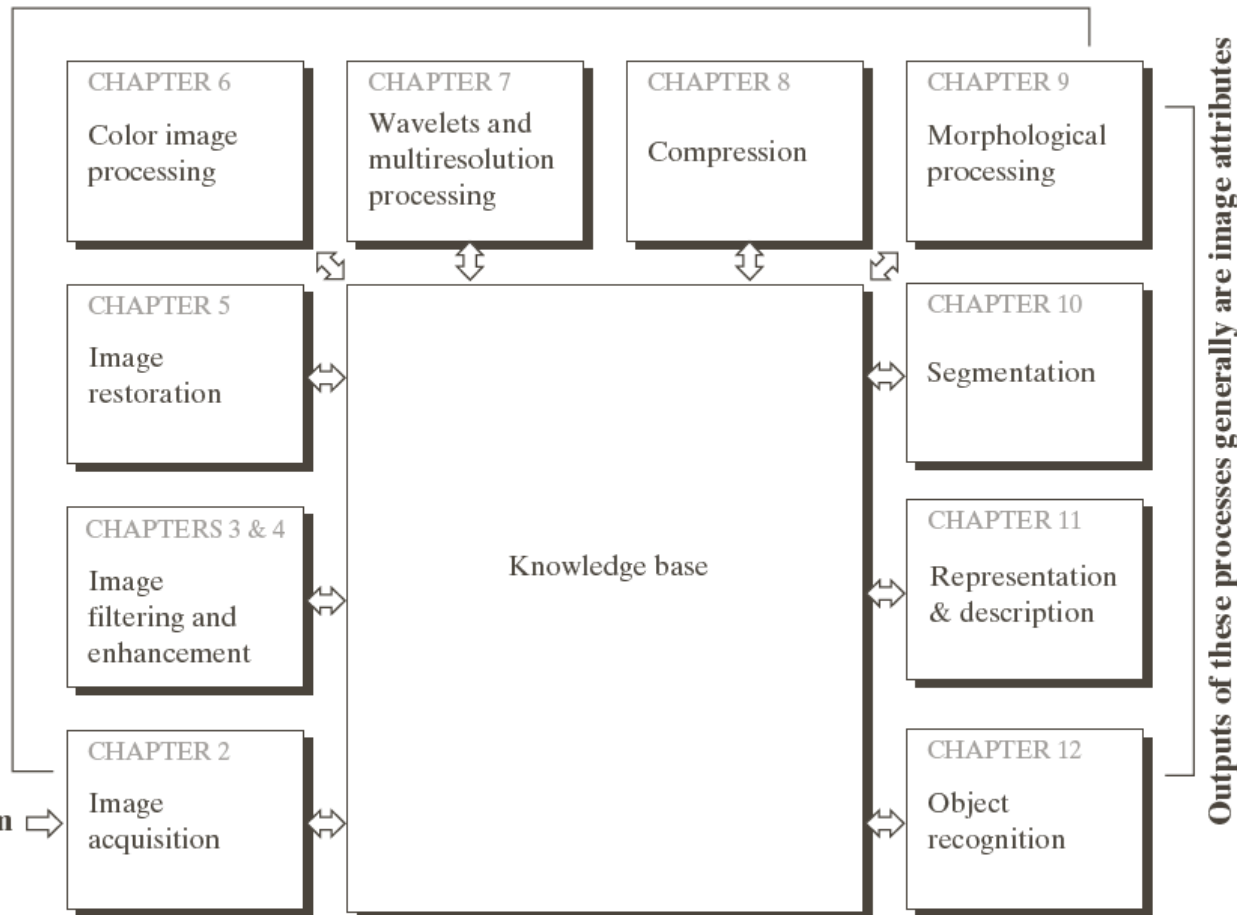
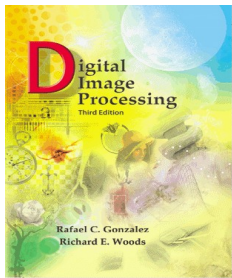


FIGURE 1.23
Fundamental steps in digital image processing. The chapter(s) indicated in the boxes is where the material described in the box is discussed.

Passos fundamentais em processamento de imagens digitais. Capítulos do livro correspondentes.



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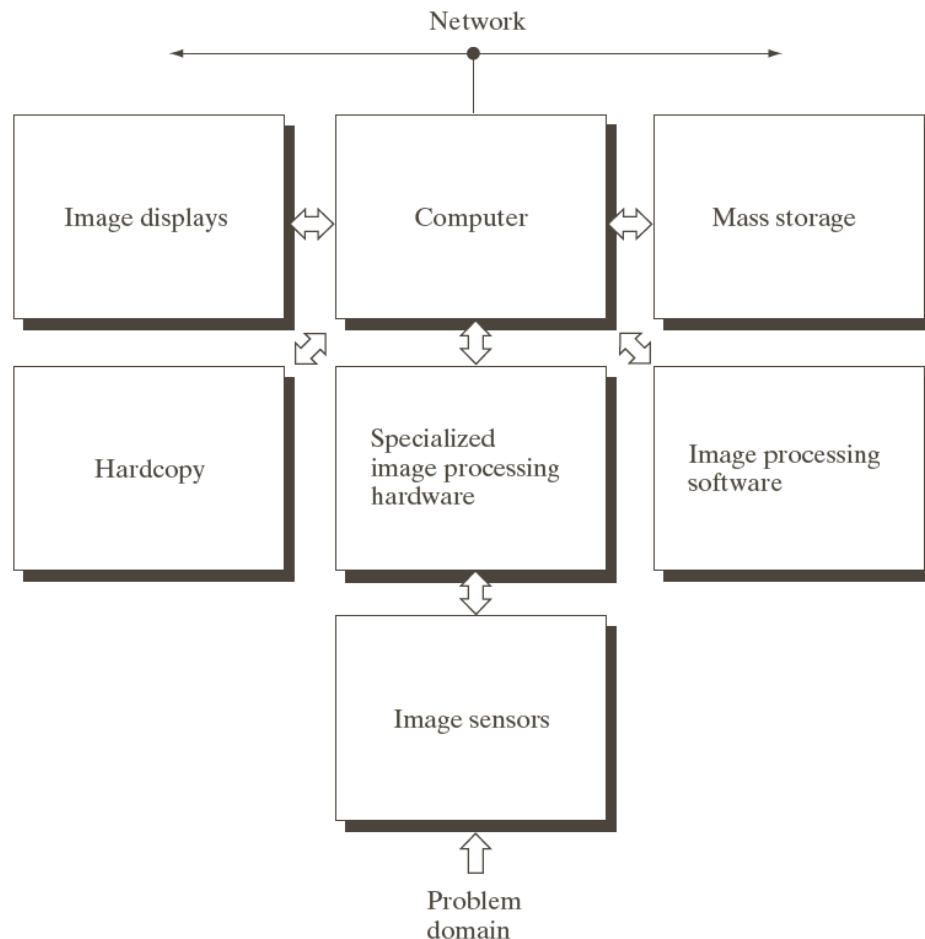


FIGURE 1.24
Components of a
general-purpose
image processing
system.

Componentes de um
sistema de processamento
de imagens de propósito
geral.