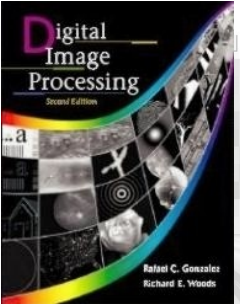


Processamento de Imagens Digitais

Introdução

Prof. Dr. Lucas Ferrari de Oliveira

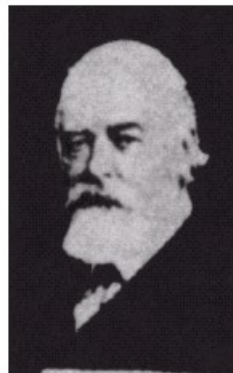


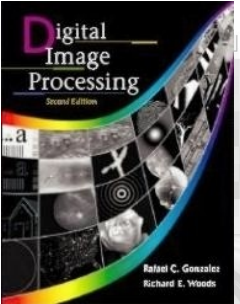
Introdução



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. Some errors are visible. (McFarlane.)



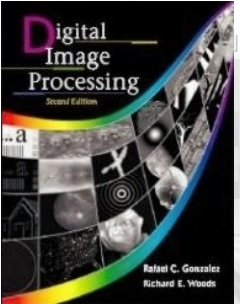


Introdução

FIGURE 1.3

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





Introdução

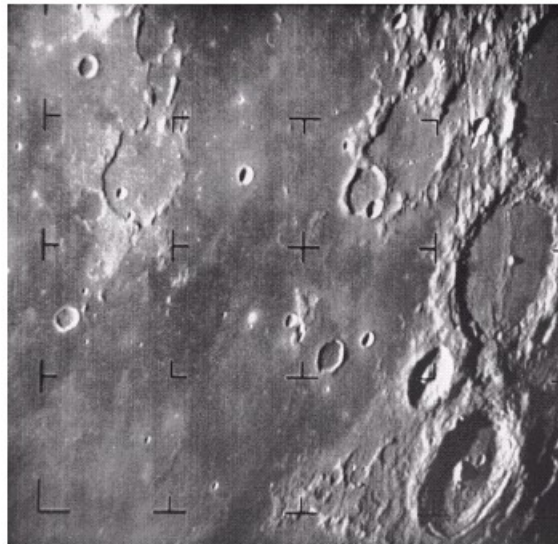
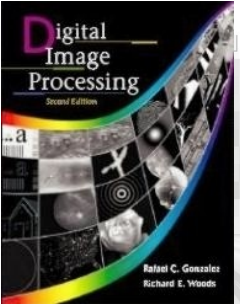


FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9:09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)



Introdução

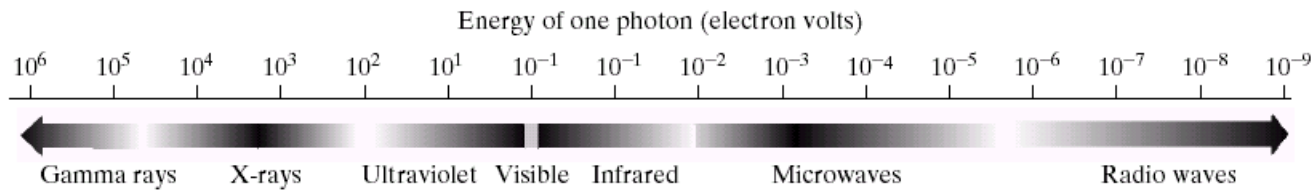
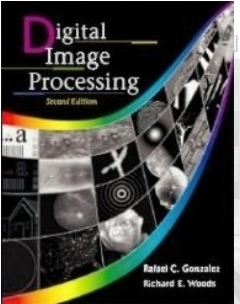


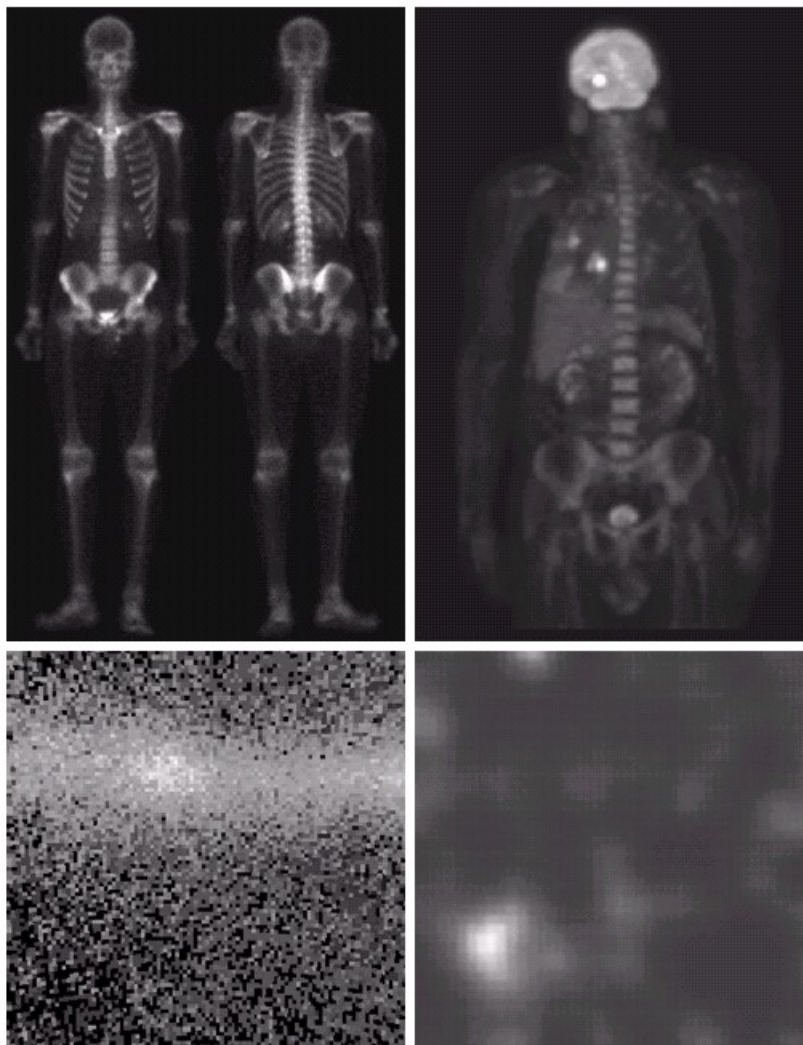
FIGURE 1.5 The electromagnetic spectrum arranged according to energy per photon.

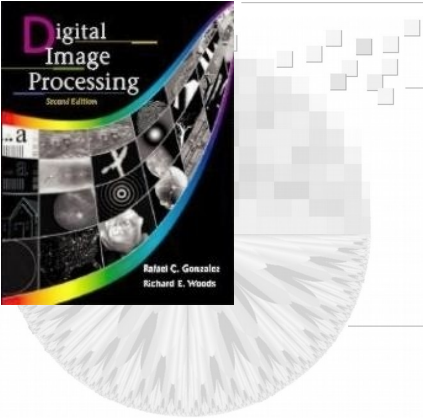


Introdução

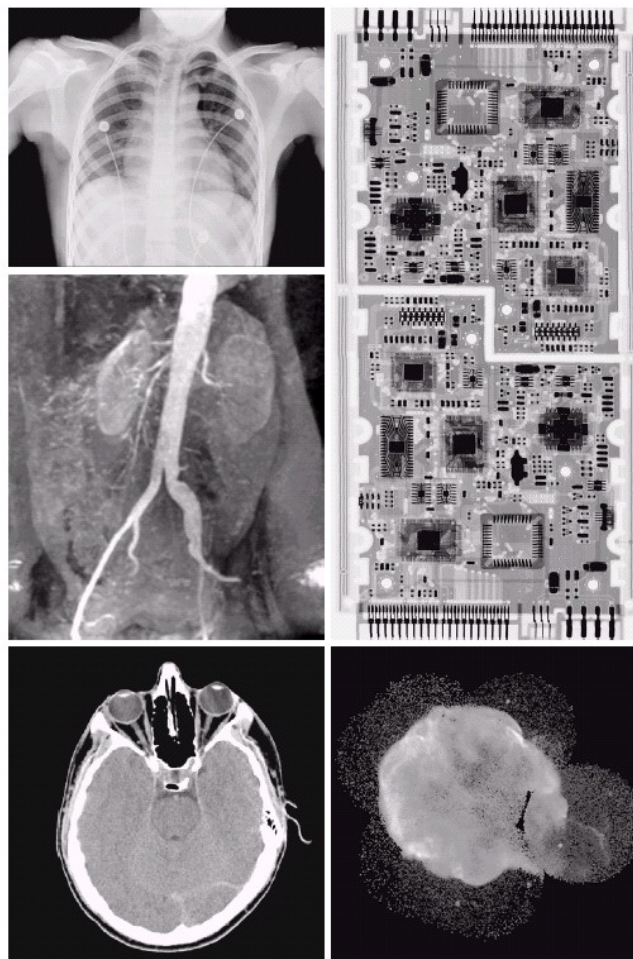
a b
c d

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.)



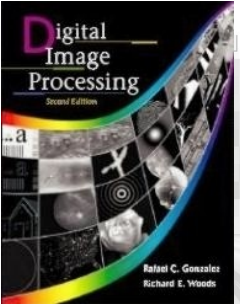


Introdução



a d
b
c e

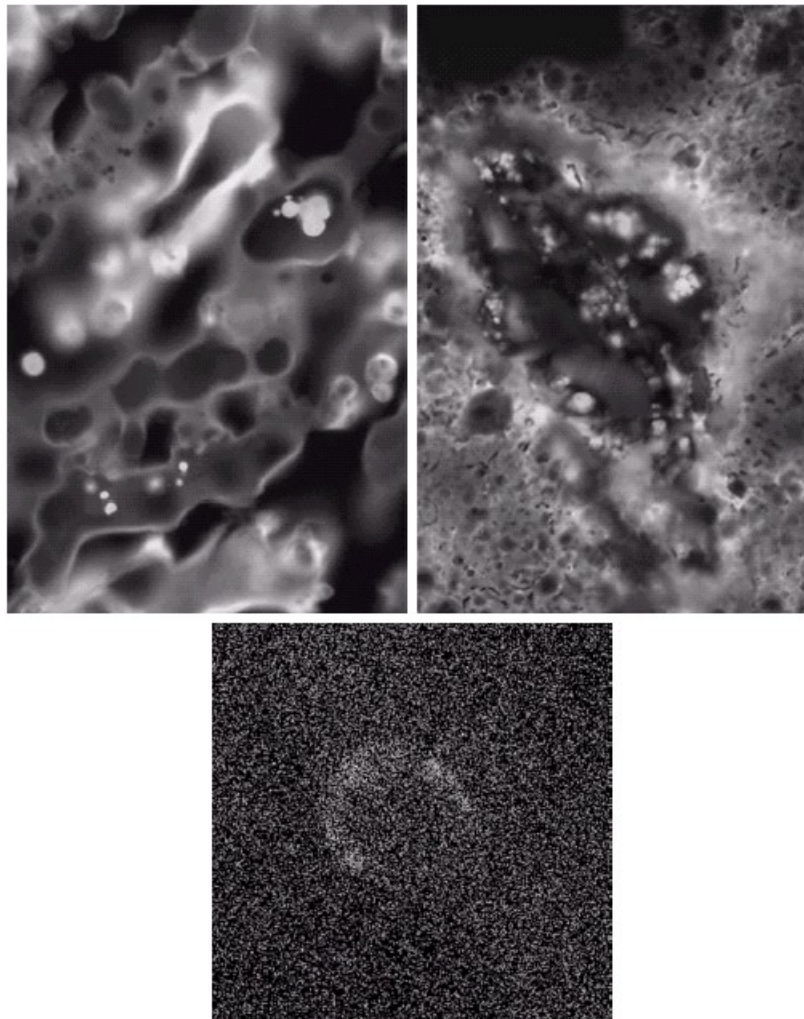
FIGURE 1.7 Examples of X-ray imaging. (a) Chest X-ray. (b) Aortic angiogram. (c) Head CT. (d) Circuit boards. (e) Cygnus Loop. (Images courtesy of (a) and (c) Dr. David R. Pickens, Dept. of Radiology & Radiological Sciences, Vanderbilt University Medical Center, (b) Dr. Thomas R. Gest, Division of Anatomical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

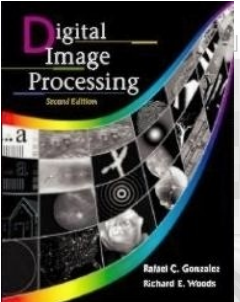


Introdução

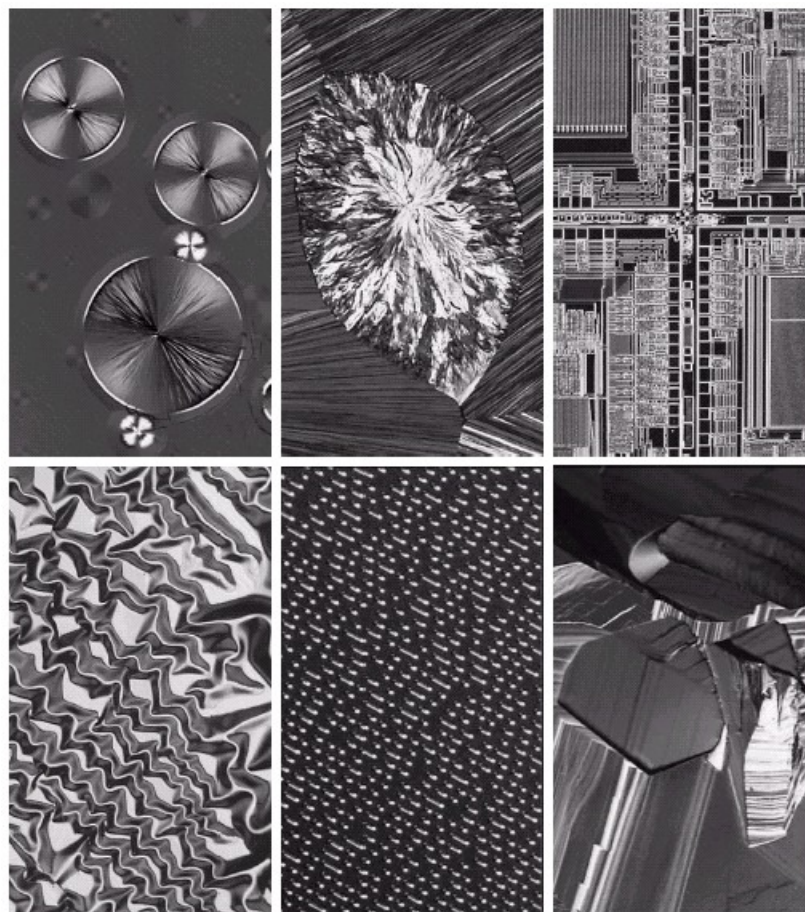
a b
c

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.)



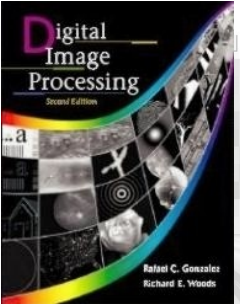


Introdução



a b c
d e f

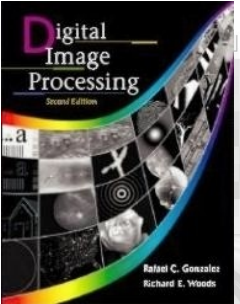
FIGURE 1.9 Examples of light microscopy images. (a) Taxol (anticancer agent), magnified 250 \times . (b) Cholesterol—40 \times . (c) Microprocessor—60 \times . (d) Nickel oxide thin film—600 \times . (e) Surface of audio CD—1750 \times . (f) Organic superconductor—450 \times . (Images courtesy of Dr.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



Introdução

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 |



Introdução

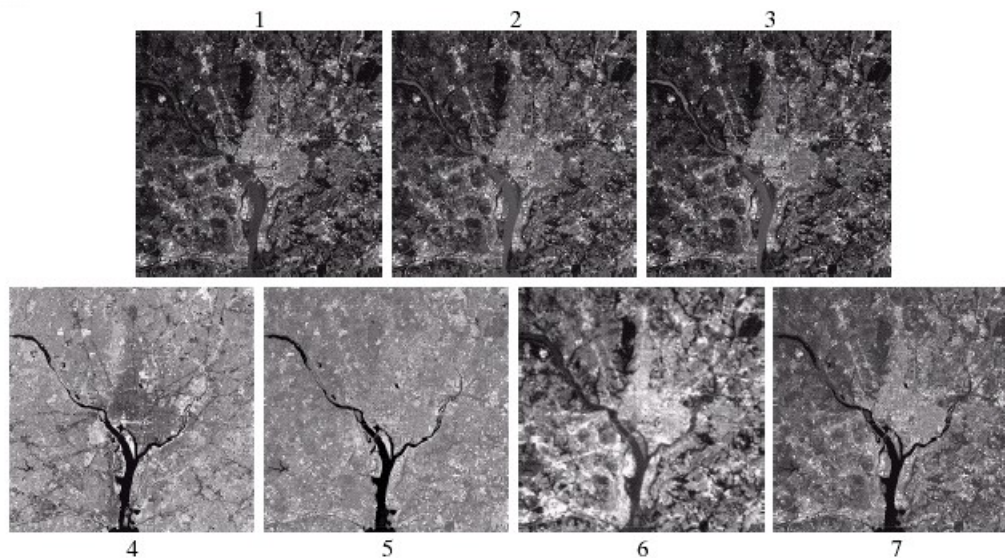
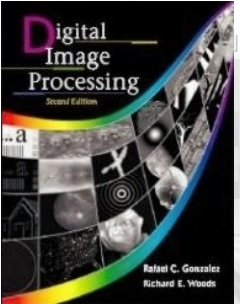


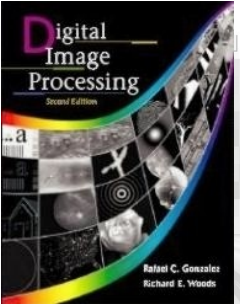
FIGURE 1.10 LANDSAT satellite images of the Washington, D.C. area. The numbers refer to the thematic bands in Table 1.1. (Images courtesy of NASA.)



Introdução

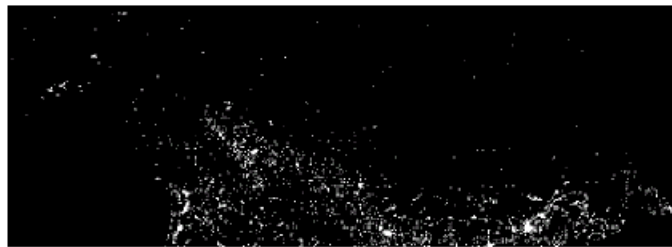


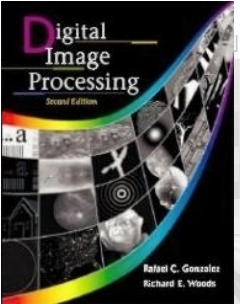
FIGURE 1.11
Multispectral
image of
Hurricane
Andrew taken by
NOAA GEOS
(Geostationary
Environmental
Operational
Satellite) sensors.
(Courtesy of
NOAA.)



Introdução

FIGURE 1.12
Infrared satellite
images of the
Americas. The
small gray map
is provided for
reference.
(Courtesy of
NOAA.)

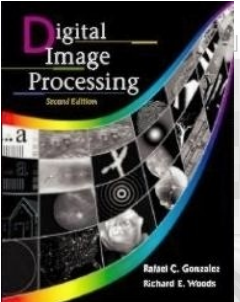




Introdução



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.)

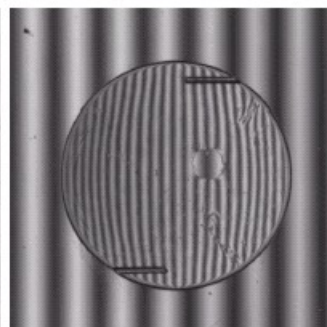
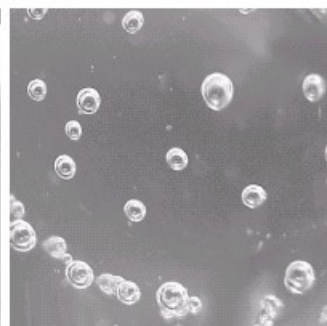
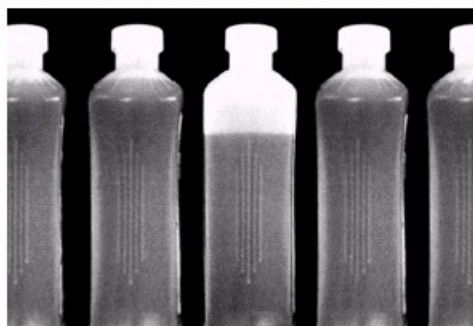
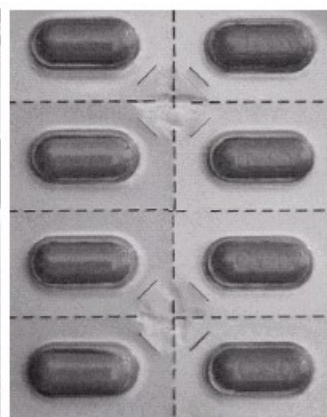
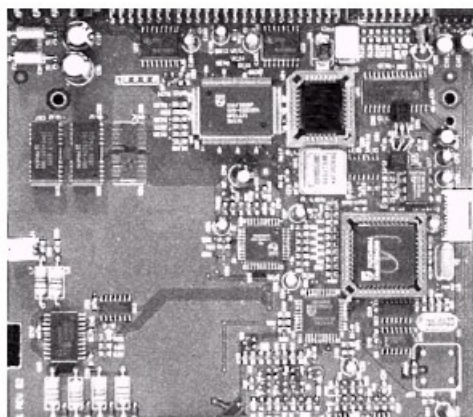


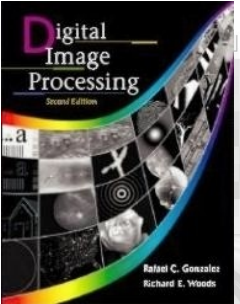
Introdução

a b
c d
e f

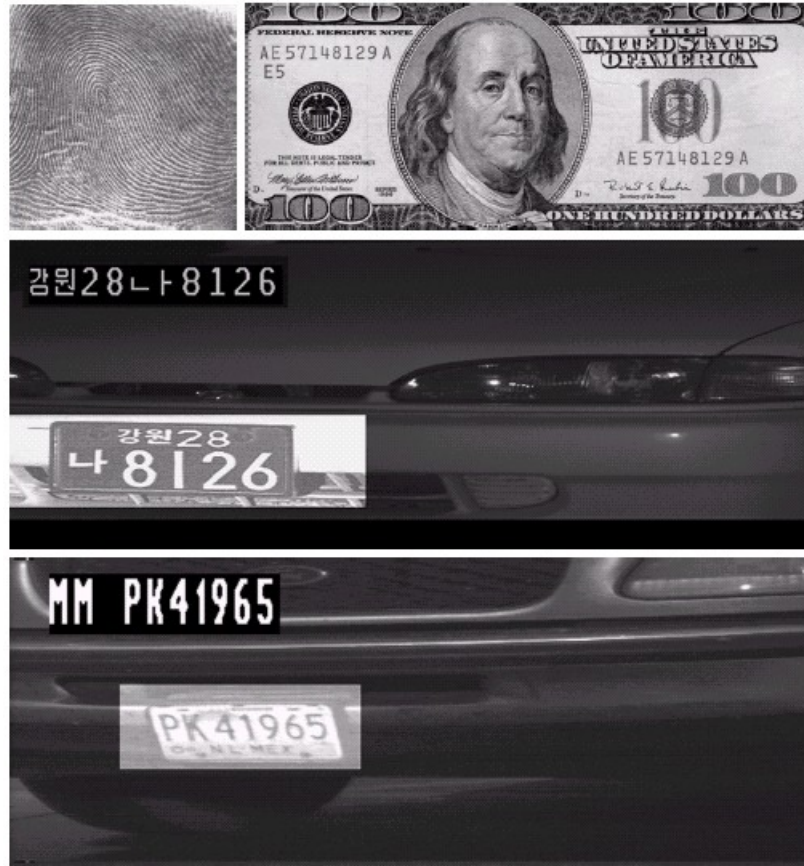
FIGURE 1.14

Some examples of manufactured goods often checked using digital image processing. (a) A circuit board controller. (b) Packaged pills. (c) Bottles. (d) Bubbles in clear-plastic product. (e) Cereal. (f) Image of intraocular implant. (Fig. (f) courtesy of Mr. Pete Sites, Perceptics Corporation.)



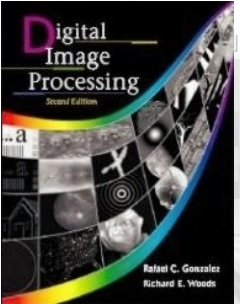


Introdução



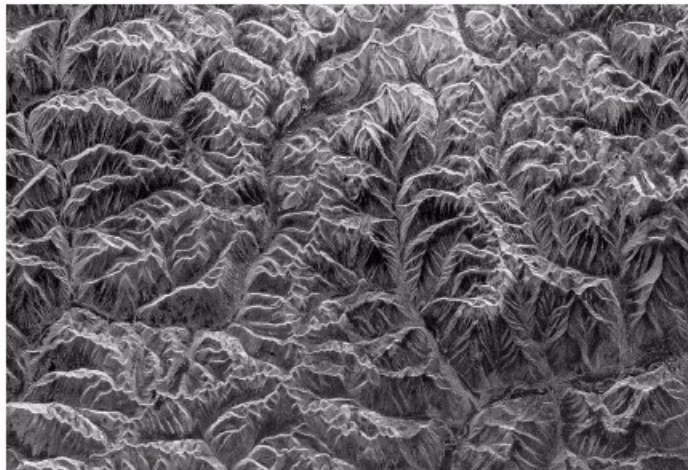
a b
c
d

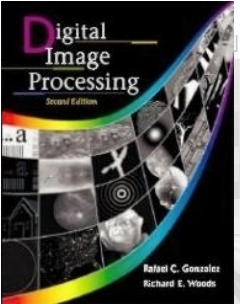
FIGURE 1.15
Some additional examples of imaging in the visual spectrum. (a) Thumb print. (b) Paper currency. (c) and (d). Automated license plate reading. (Figure (a) courtesy of the National Institute of Standards and Technology. Figures (c) and (d) courtesy of Dr. Juan Herrera, Perceptics Corporation.)



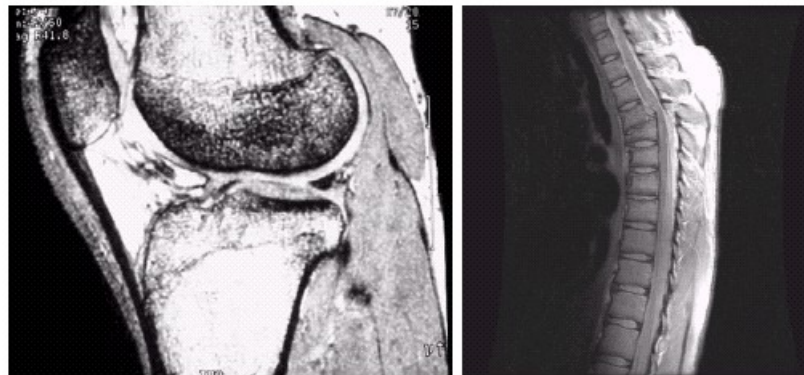
Introdução

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



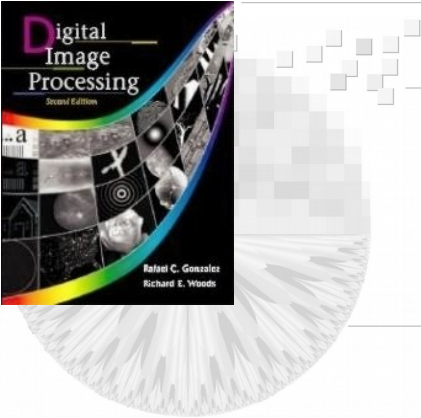


Introdução



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.)



Introdução

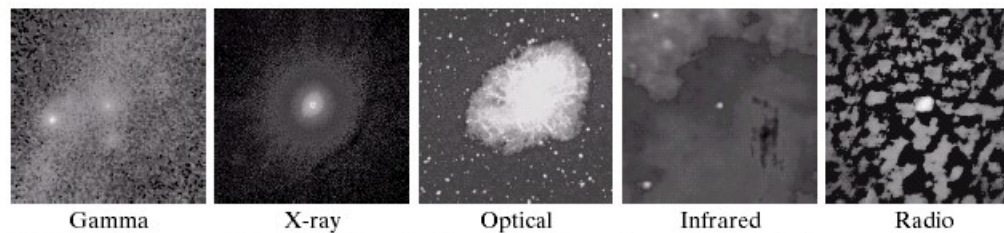
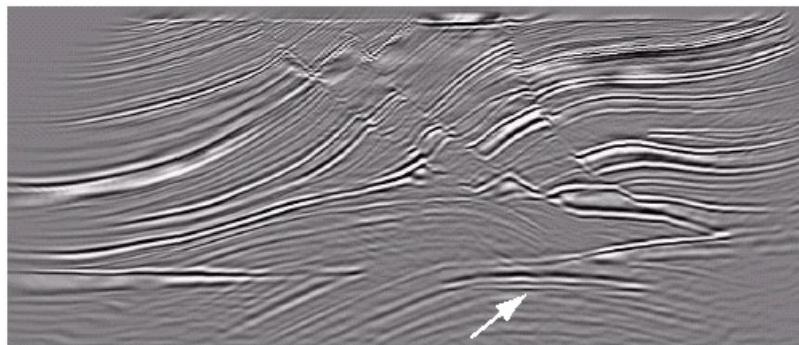
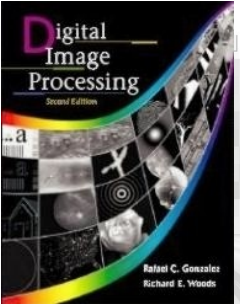


FIGURE 1.18 Images of the Crab Pulsar (in the center of images) covering the electromagnetic spectrum. (Courtesy of NASA.)

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.)



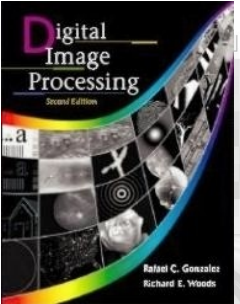


Introdução

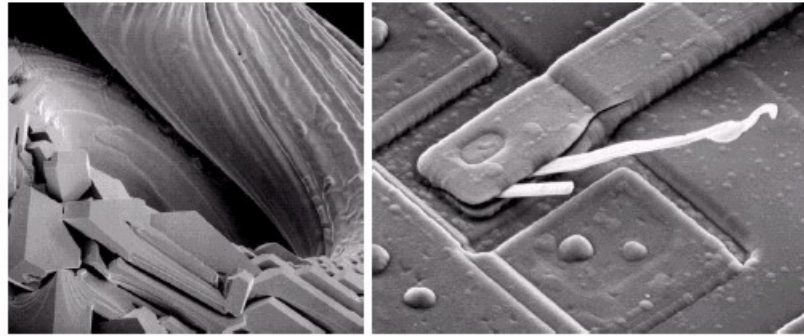


a b
c d

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.)

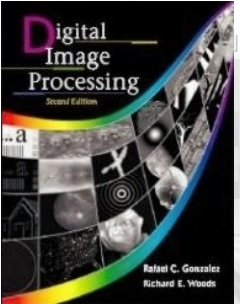


Introdução

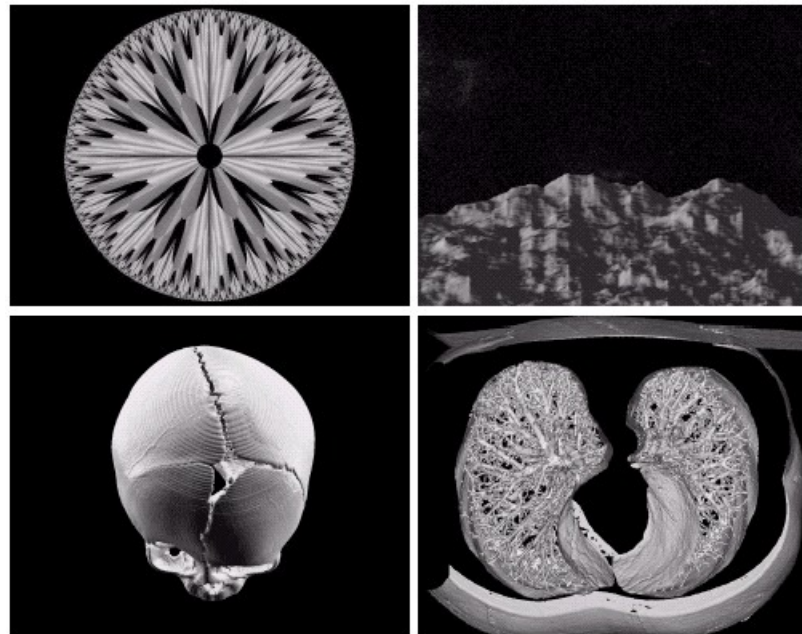


a b

FIGURE 1.21 (a) 250 \times SEM image of a tungsten filament following thermal failure. (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.)

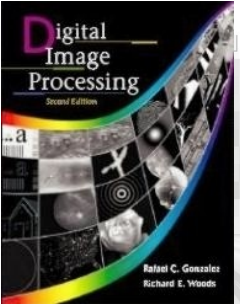


Introdução



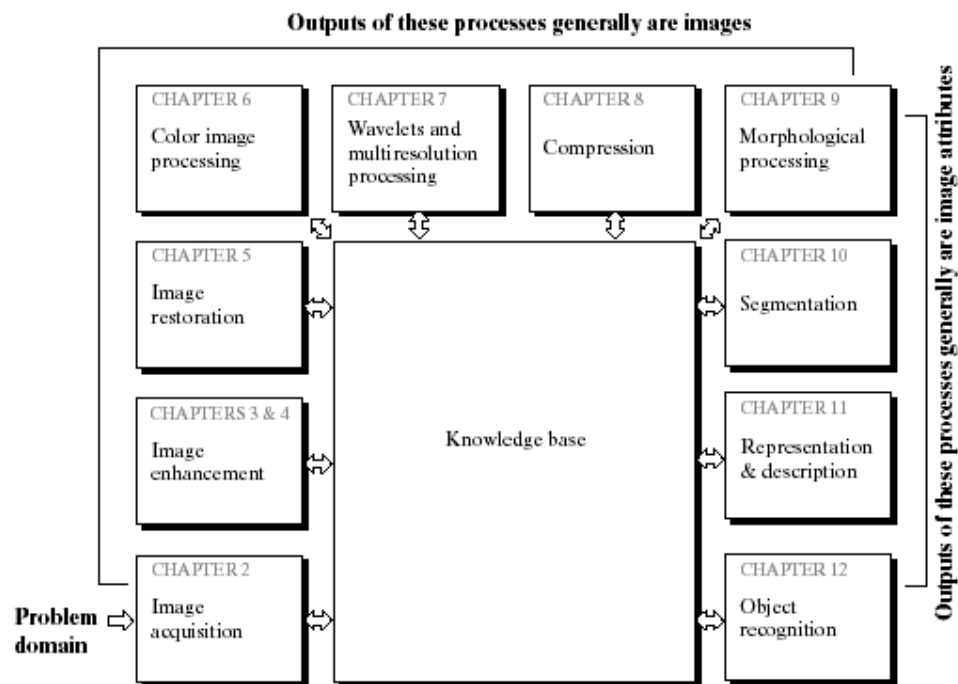
a b
c d

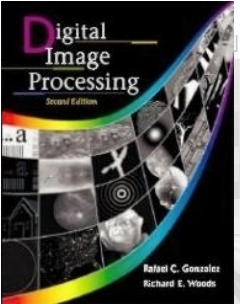
FIGURE 1.22
(a) and (b) Fractal
images. (c) and
(d) Images
generated from
3-D computer
models of the
objects shown.
(Figures (a) and
(b) courtesy of
Ms. Melissa
D. Binde,
Swarthmore
College, (c) and
(d) courtesy of
NASA.)



Introdução

FIGURE 1.23
Fundamental
steps in digital
image processing.





Introdução

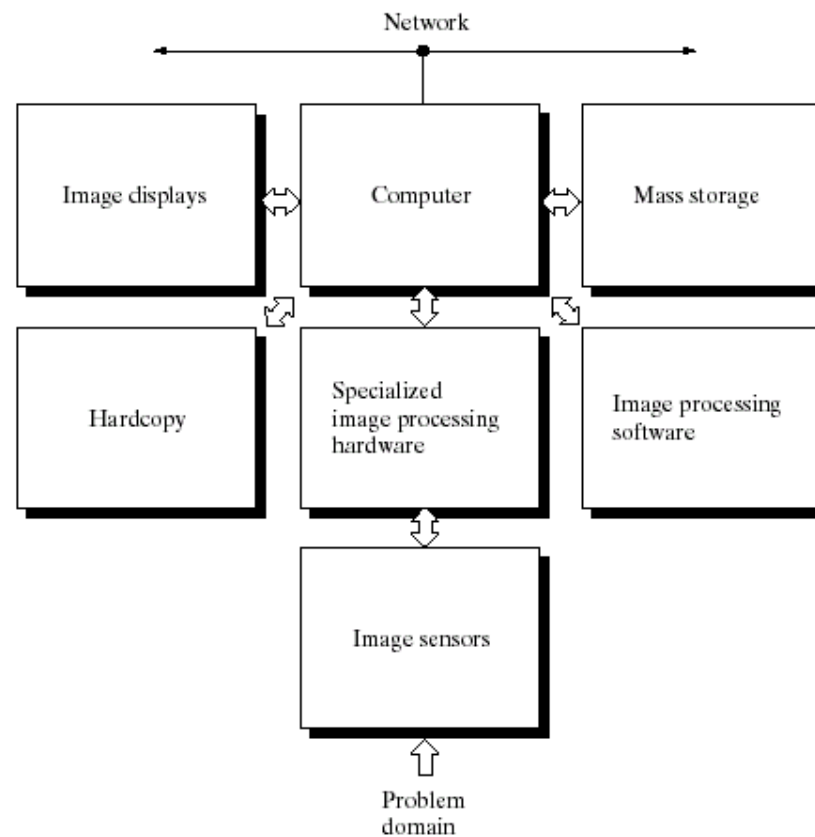


FIGURE 1.24
Components of a
general-purpose
image processing
system.