Capítulo 1 - Motivação

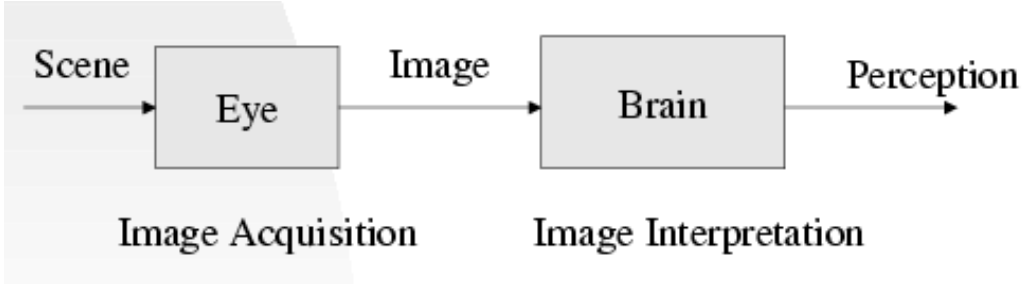
Processamento de Imagem e Visão

Índice

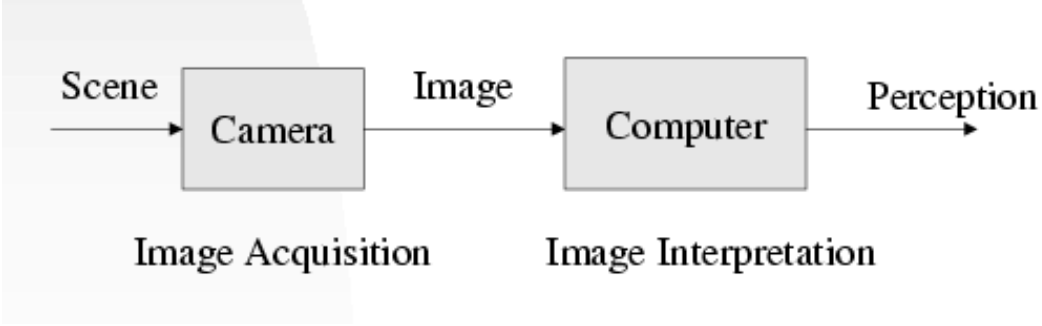
- O que é Processamento Digital de Imagem?
- Imagens digitais ao longo da história;
- Aplicações (fonte de energia):
  - Electromagnético;
  - Acústico;
  - Ultra-som;
  - Electrónico (feixes de electrões);
- Componentes de um sistema de PDI;

O que é Processamento Digital de Imagem?

A visão é o mais avançado sistema sensorial humano!



Naturalmente, tentamos reproduzir essas capacidades utilizando máquinas.



O que é Processamento Digital de Imagem?

Uma imagem pode ser definida por:

$f(x, y)$ onde x, y são coordenadas espaciais e f define a intensidade ou cor desse ponto.

Se x, y e f são discretos e finitos, a imagem é considerada digital.

Assim, uma definição de PDI:

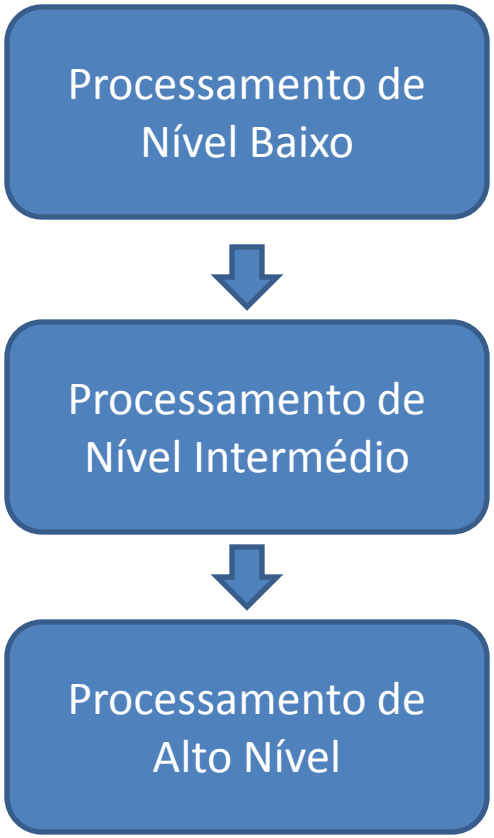
Processamento de imagens digitais a partir de dispositivos digitais, como por exemplo, um computador

Áreas Relacionadas

- *Image understanding*
- Análise de imagem (*image analysis*)
- Visão por computador (*computer vision*)
- Computação gráfica (*computer graphics*)
- Reconhecimento de padrões (pattern recognition)
- Inteligência artificial (*artificial Intelligence*)
- Etc…

Fronteiras

- Difusas!



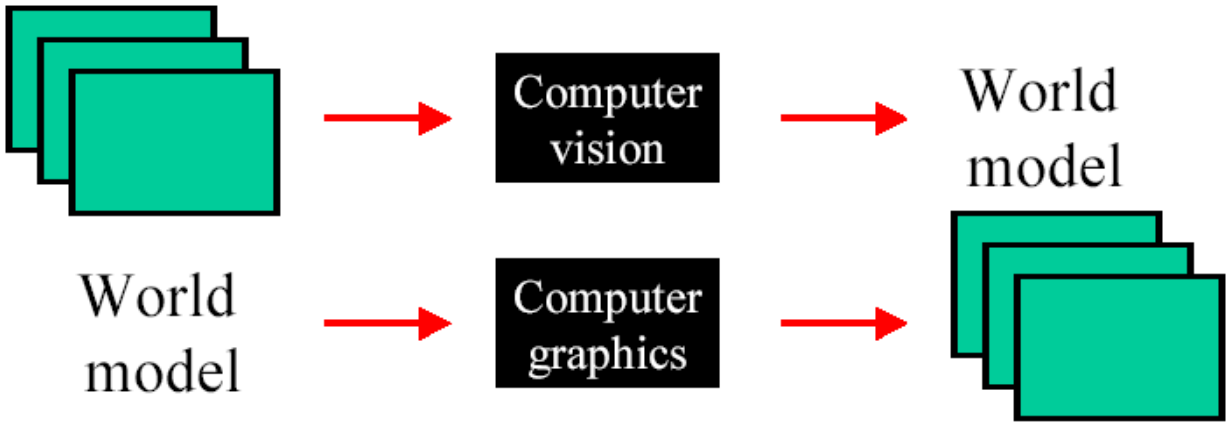
Pre-processamento:

Redução de ruído; realçamento de imagens; intensificação de características

Segmentação; descrição de regiões ou objectos; classificação

Interpretação da cena

Visão por Computador e Computação Gráfica



Imagens Digitais ao Longo da História

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

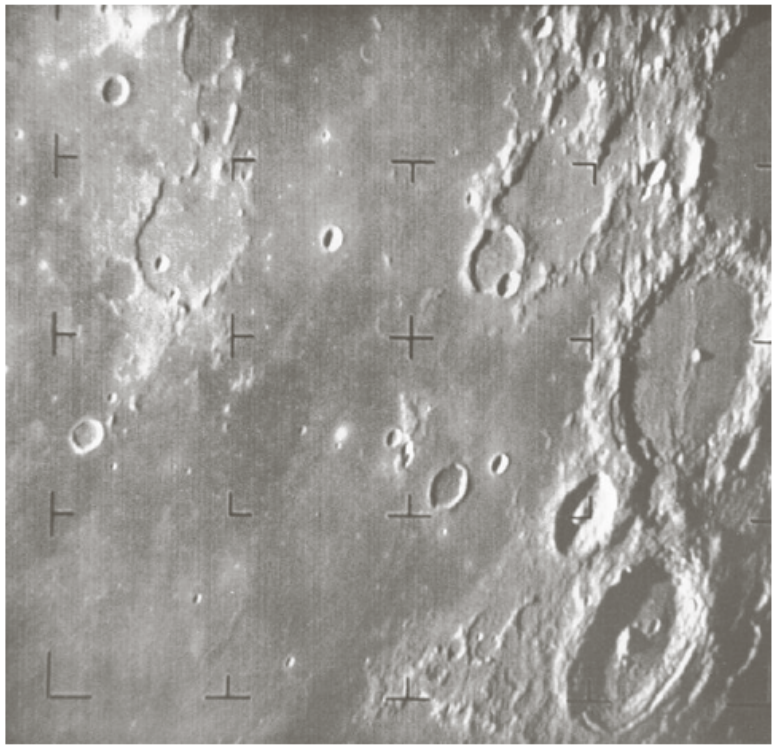


FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9 : 09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

Imagens Digitais ao Longo da História

- Marcos relacionado com a era digital

1940 – Máquina de von Neumann (CPU);

1948 – Invenção do transístor (Bell Labs);

1950/60 – Desenvolvimento de linguagens como o COBOL e FORTRAN;

1958 – Invenção do circuito integrado (Texas);

1960 – Desenvolvimento dos sistemas operativos;

1970 – Desenvolvimento dos microprocessadores (Intel);

1981 – Introdução do computador pessoal (IBM);

1980 → Miniaturização dos componentes (LI, VLSI, ULSI), armazenamento e visualização.

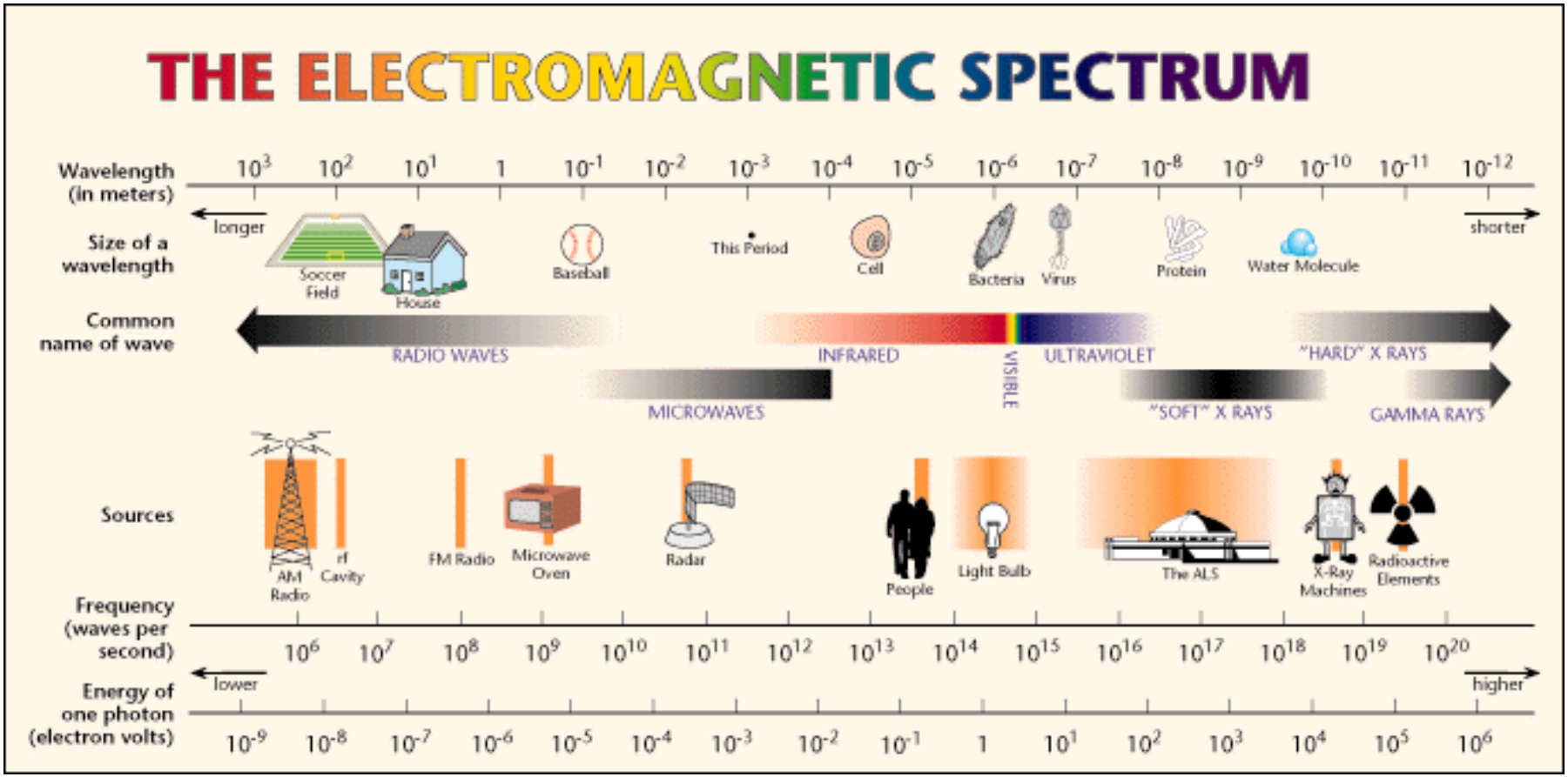
Aplicações

- Existem áreas onde não se utiliza processamento digital de imagem?

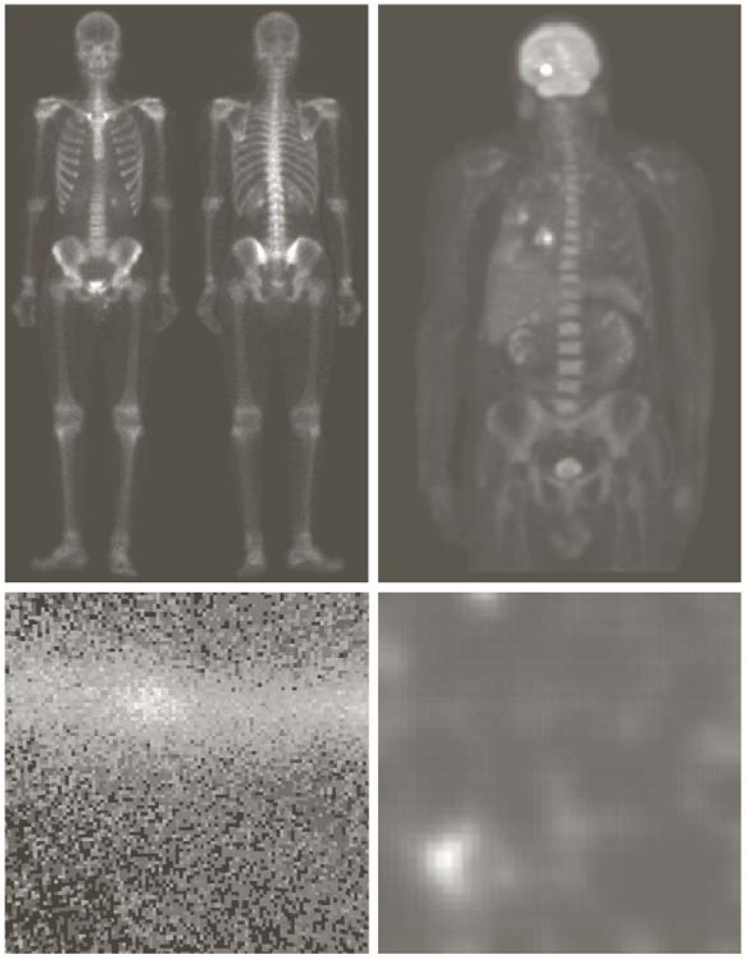
Uma forma de descrever as suas aplicações é recorre à fonte de energia do sinal:

- Electromagnético;
- Acústico;
- Ultra-som;
- Electrónico (feixes de electrões);

Espectro Electromagnético



Imagens nos Raios Gama



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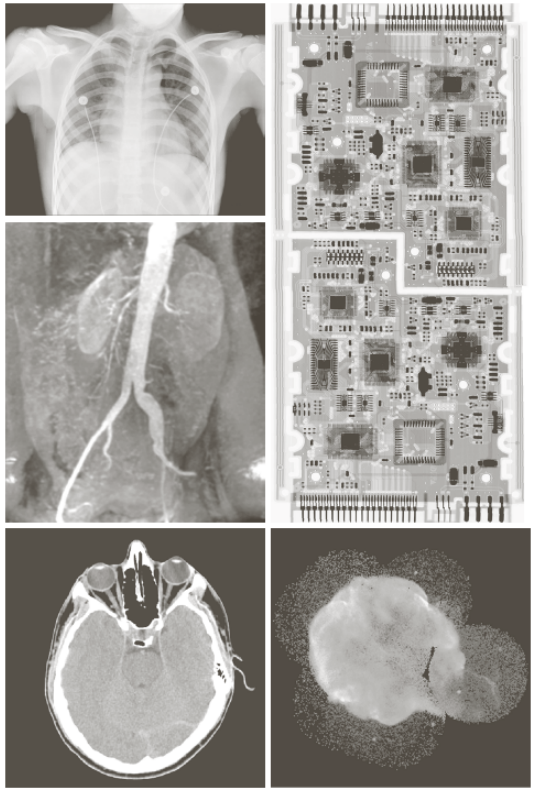
c d

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.)

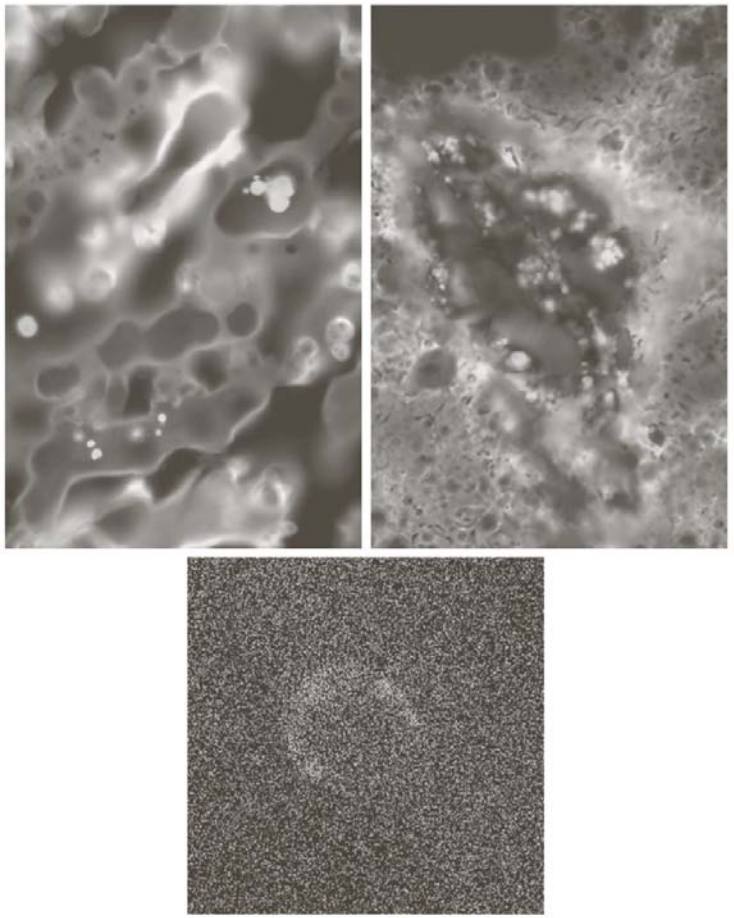
Imagens nos Raios X



a b c d 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.)

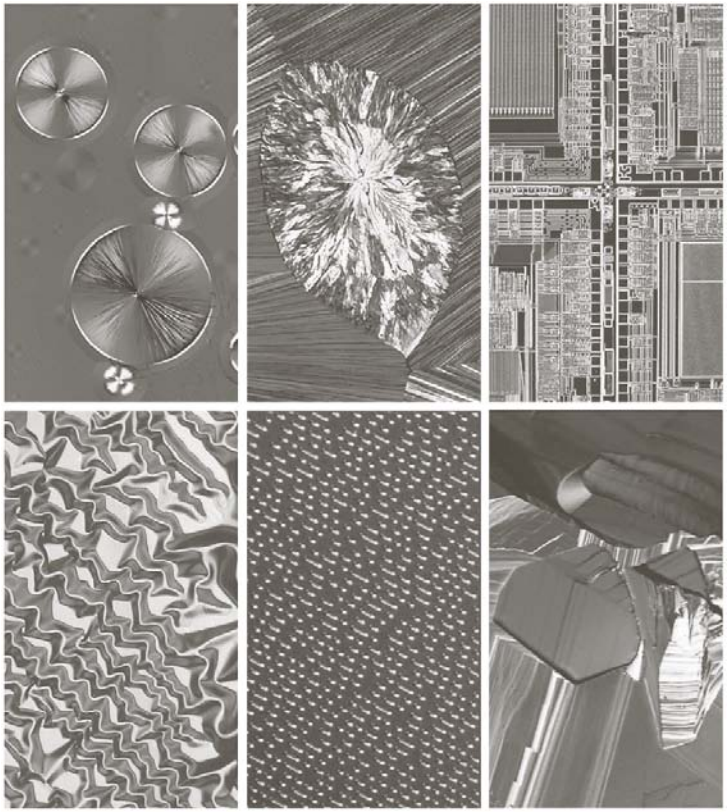
Imagens na Banda UV



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.)

Imagens na Banda Visível (1)



a b c
d e f

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

Imagens na Banda Visível (2)

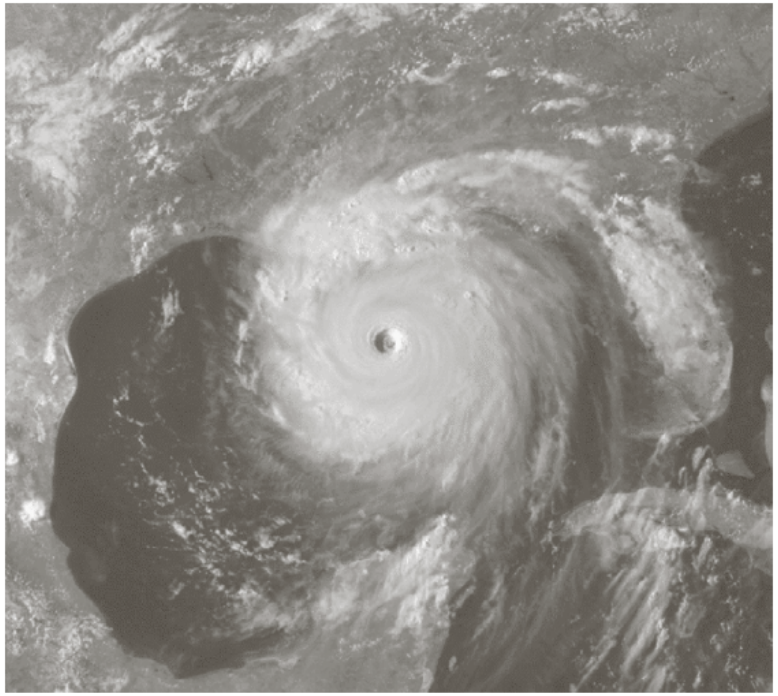
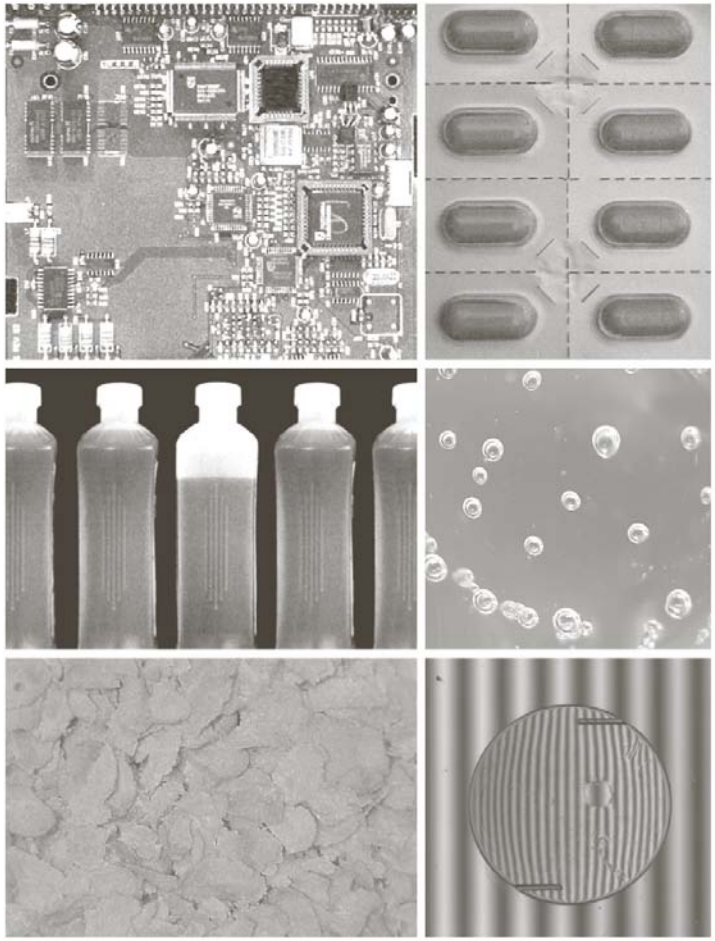


FIGURE 1.11
Satellite image of Hurricane Katrina taken on August 29, 2005. (Courtesy of NOAA.)

Imagens na Banda Visível (3)



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.)

Imagens na Banda Visível (4)

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.)

Imagens na Banda Infravermelha (1)

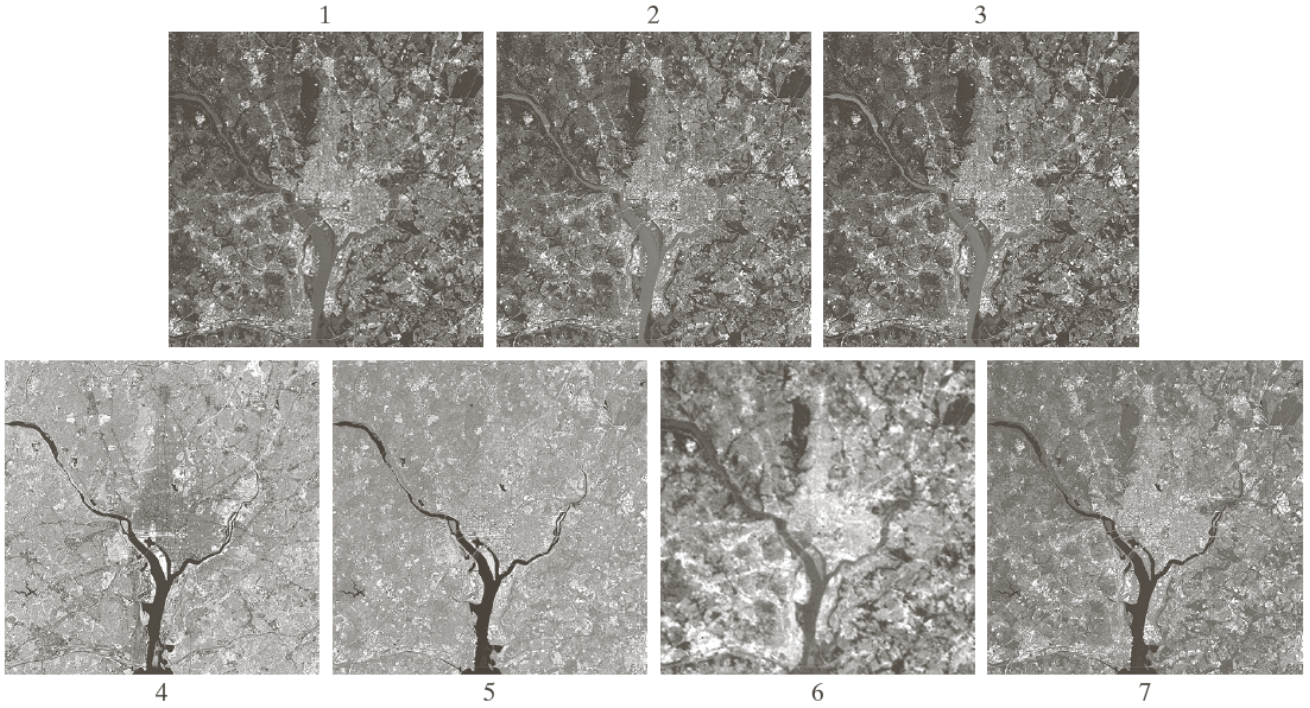


FIGURE 1.10 LANDSAT satellite images of the Washington, D.C. area. The numbers refer to the thematic bands in Table 1.1. (Images courtesy of NASA.)

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

TABLE 1.1 Thematic bands in NASA's LANDSAT satellite.

Imagens na Banda IV (2)

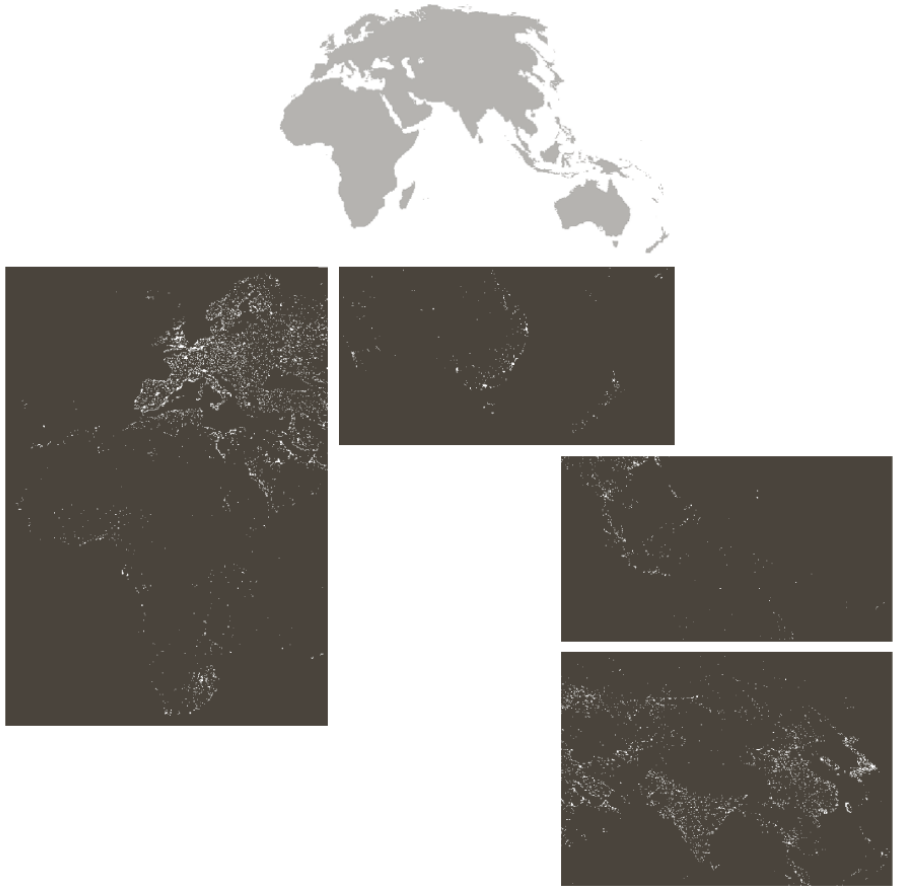
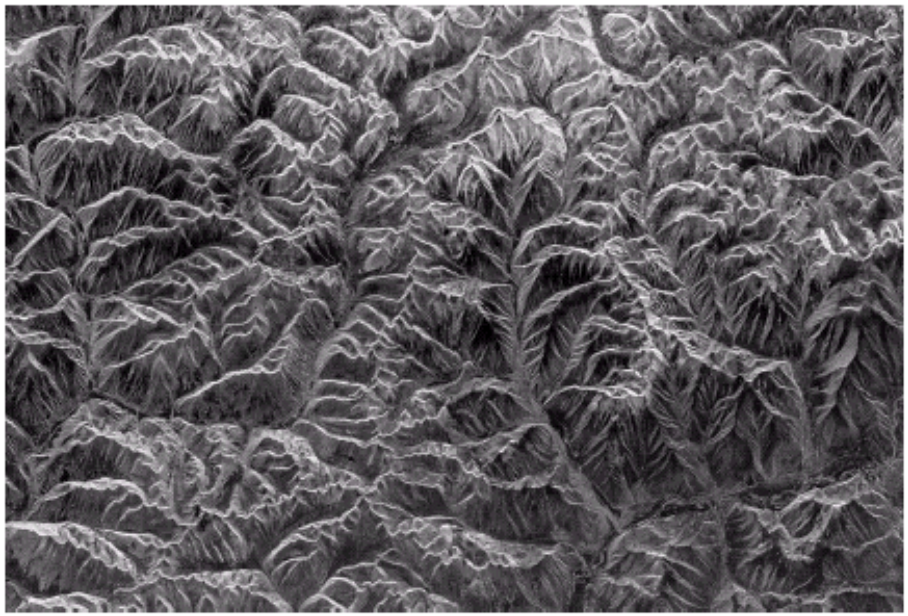


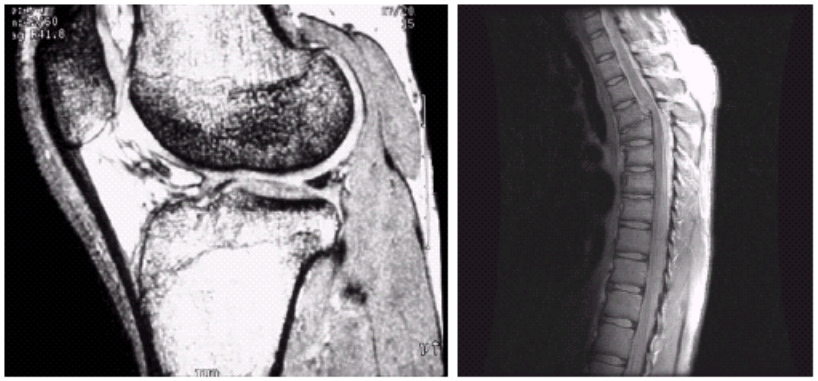
FIGURE 1.13
Infrared satellite images of the remaining populated part of the world. The small gray map is provided for reference. (Courtesy of NOAA.)

Imagens na Banda de Microondas

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



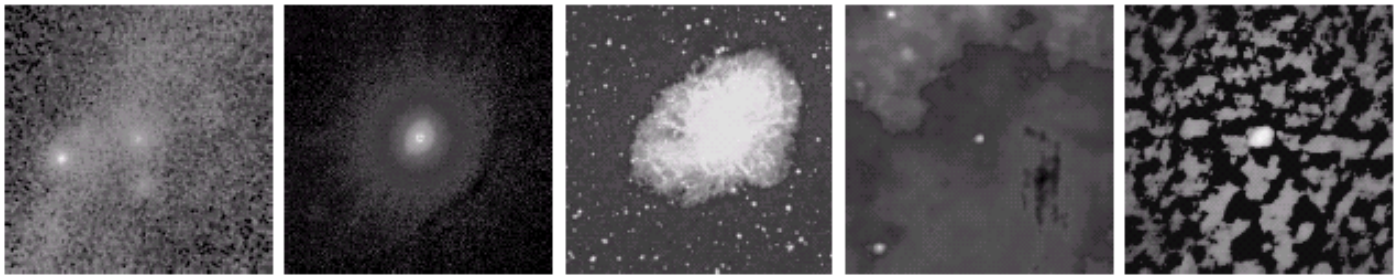
Imagens na Banda Rádio



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.)

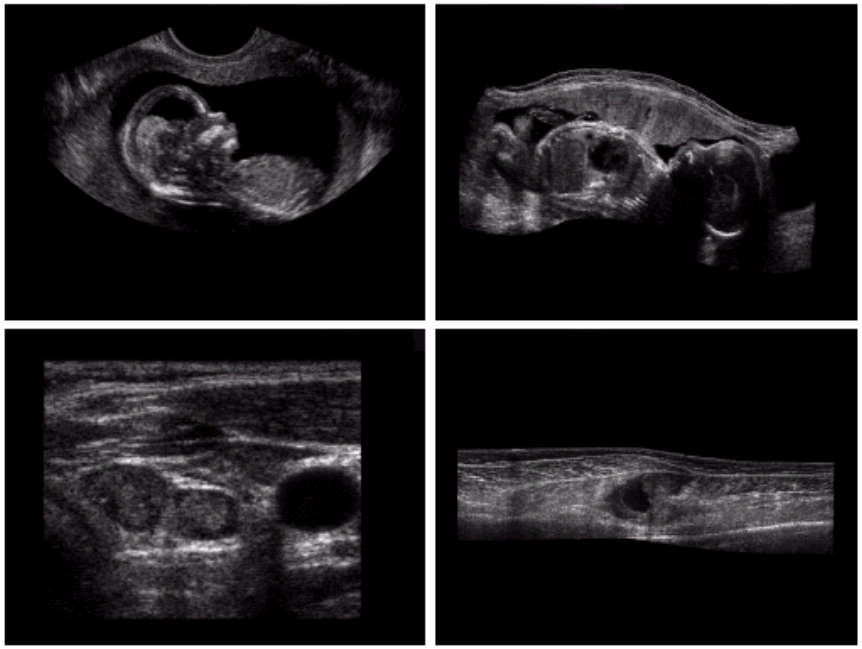
Imagens em Várias Bandas



Gamma X-ray Optical Infrared Radio

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

Imagens de Ultra-sons



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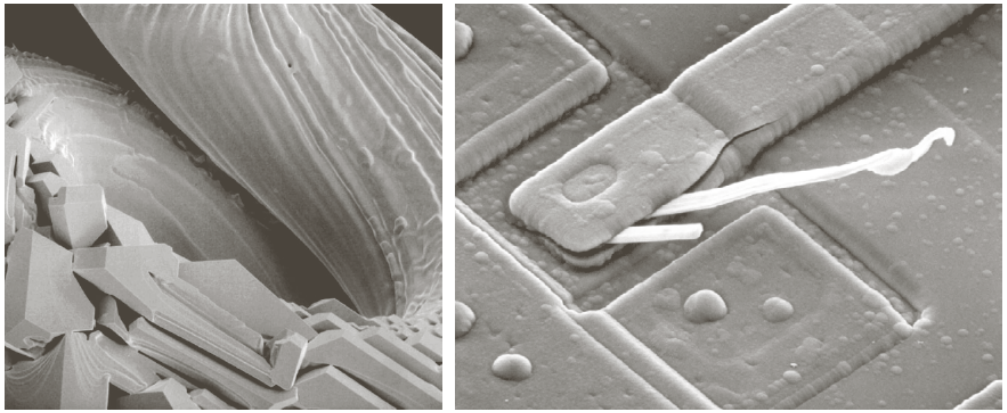
c d

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.)

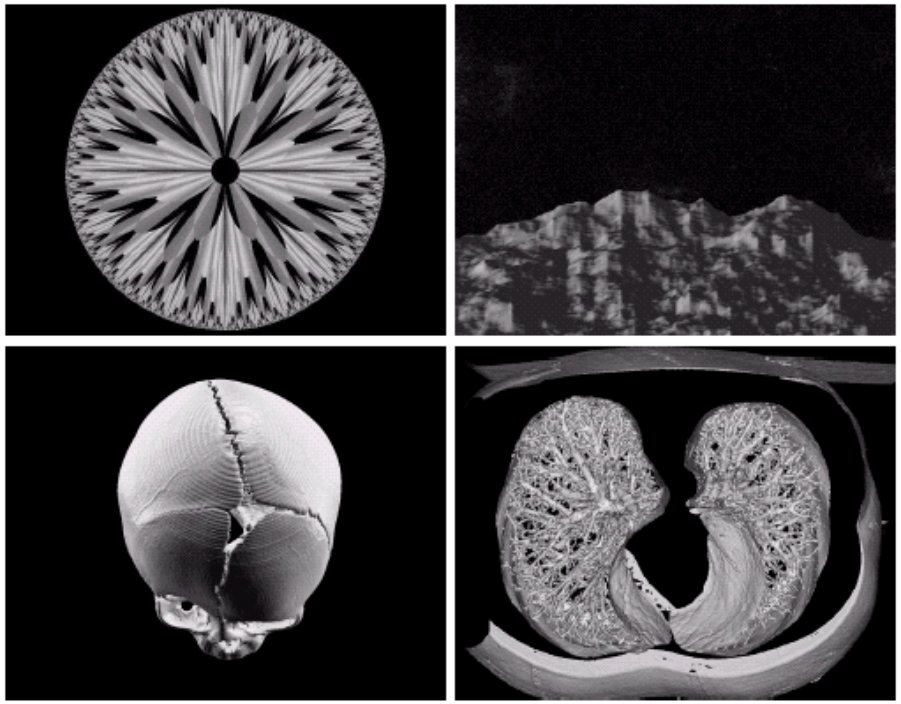
Imagens de Microscopia Electrónica de Varrimento



a b

FIGURE 1.21 (a) 250× SEM image of a tungsten filament following thermal failure (note the shattered pieces on the lower left). (b) 2500× 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.)

Imagens Sintéticas



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.)

Componentes de um Sistema de PDI

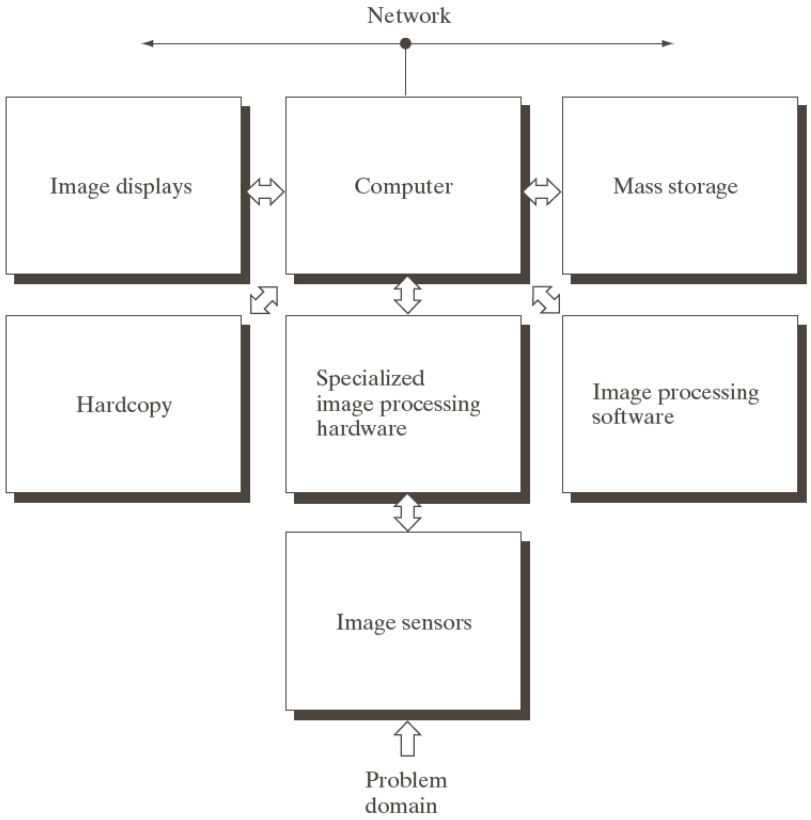


FIGURE 1.24 Components of a general-purpose image processing system.

Leitura Sugerida

- Capítulos 1 de R. Gonzalez, R. Woods, “Digital Image Processing”, 3ª edição, 2008.