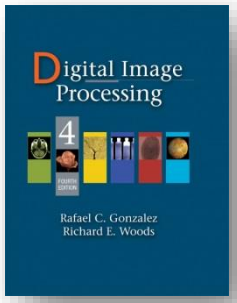


Chapter 1

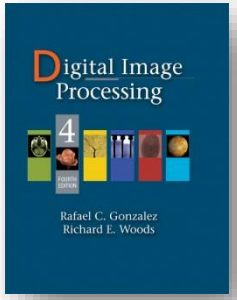
Introduction

数字图像处理

刘袁缘

中国地质大学（武汉）计算机学院

liuyy@cug.edu.cn



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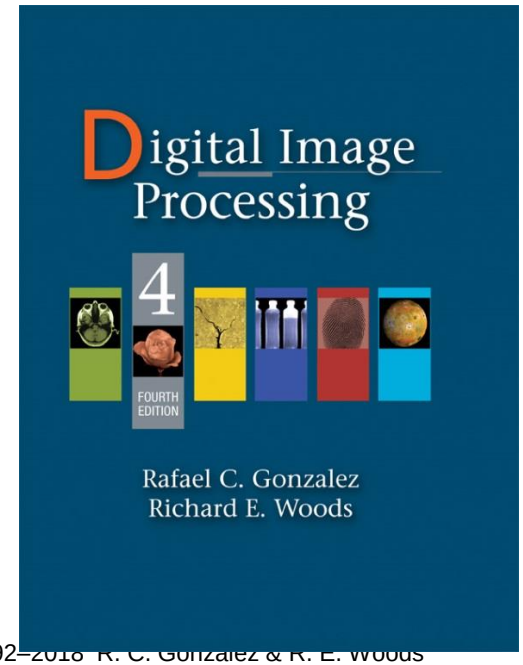
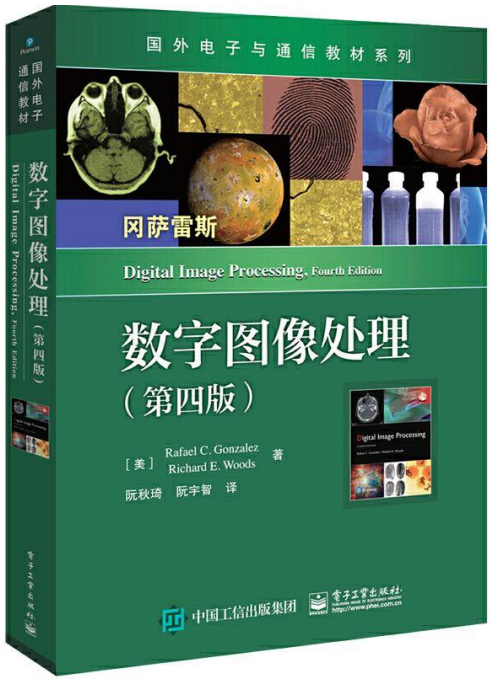
参考教材

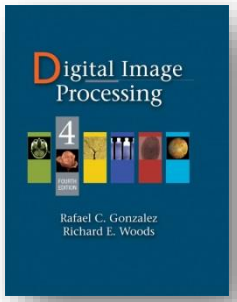
数字图像处理（第四版） **Rafael C. Gonzalez, Richard E. Woods**

数字图像处理（第二版） 许录平

考勤作业10%、实习40%、期末50%



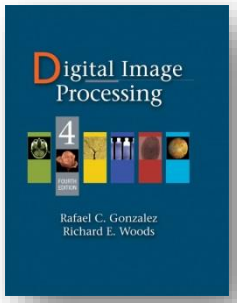




Chapter 1
Introduction

数字图像处理目的

- 改善图像的视觉效果
- 便于存储、传输和提取图像信息
- 计算机视觉



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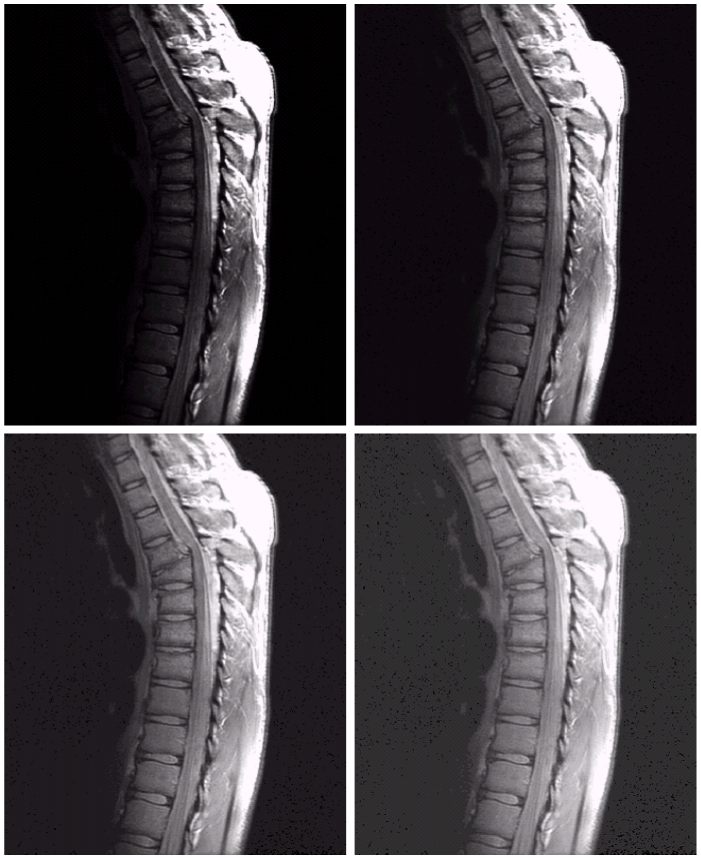
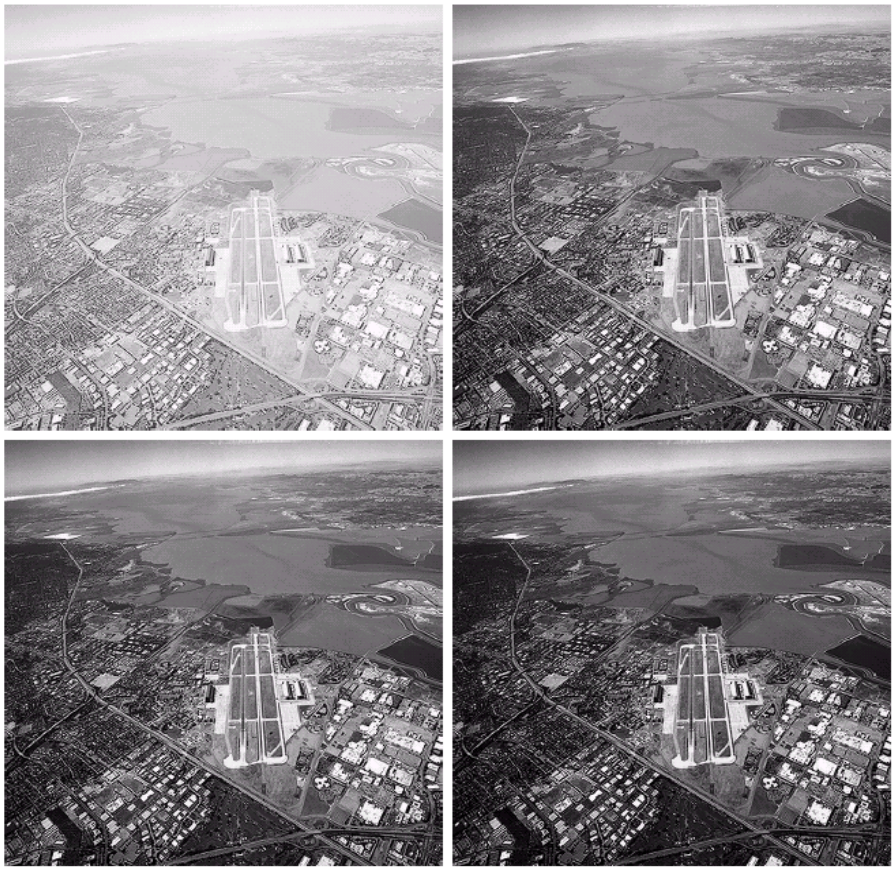
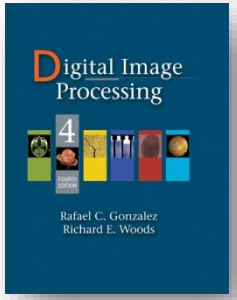




改善视觉效果



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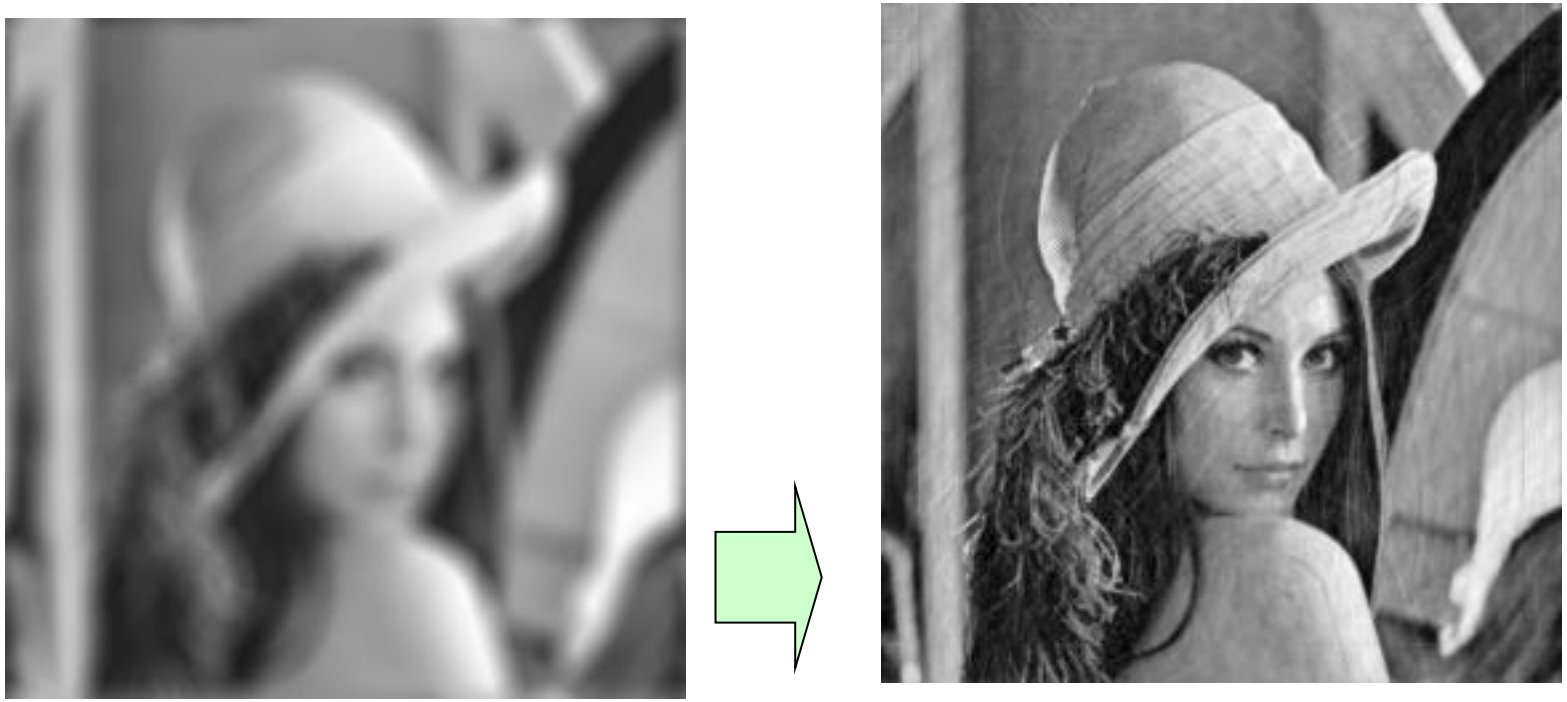
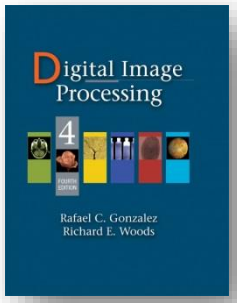


图像增强



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Chapter 1
Introduction

原始图像

20M

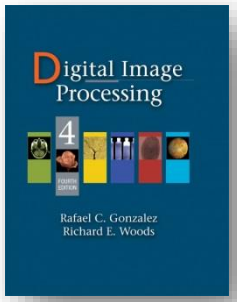
编码结果

```
10101010110101000001001
00100010111110010101111
11111111000000000000001
00000111101010000000000
11111111110101011011011
00000000000011011000000
00100000101010000000000
```

编码压缩

解码图像

5M



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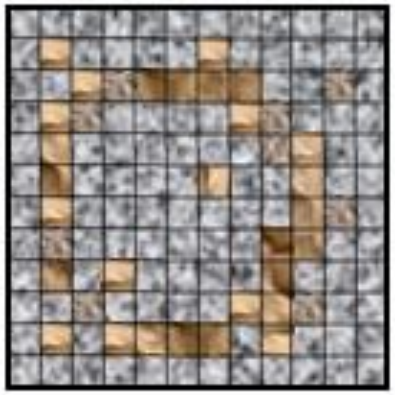
图像分析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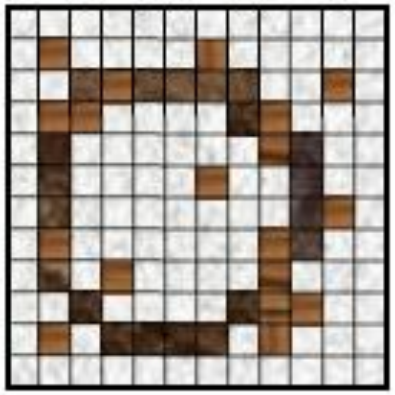
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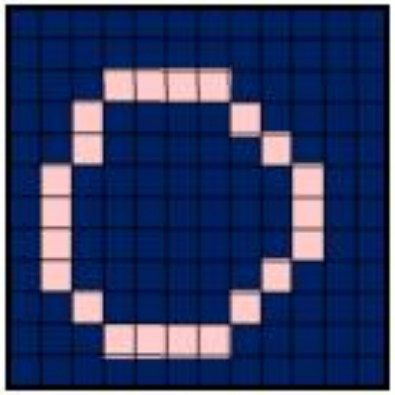
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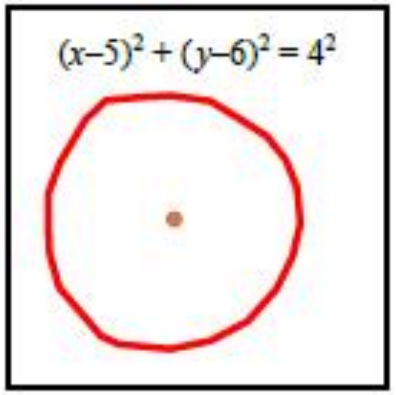

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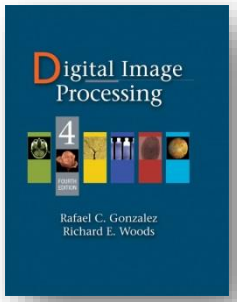

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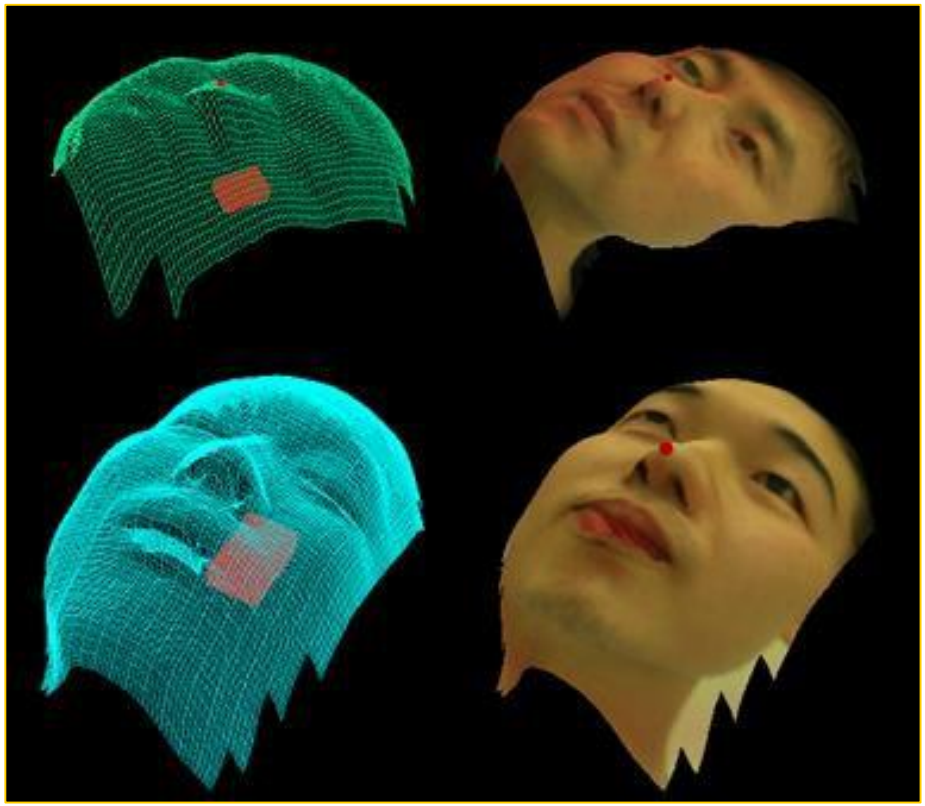
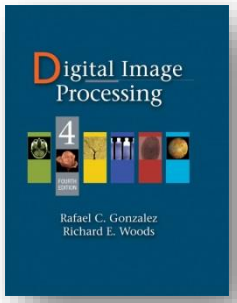
Introduction

计算机视觉

- 人脸整容





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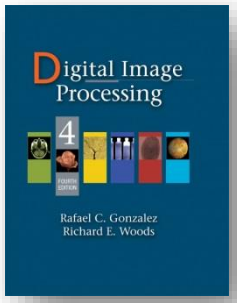
Introduction

- 课程内容简介

- 数字图像处理
  - 图像处理基础
    - 第一章 概述
    - 第二章 数字图像处理基础
    - 第三章 图像变换
  - 图像处理技术
    - 第四章 图像增强
    - 第五章 图像恢复
    - 第六章 图像压缩编码
  - 图像分析方法
    - 第七章 图像分割
    - 第八章 图像描述
    - 第九章 图像分类识别



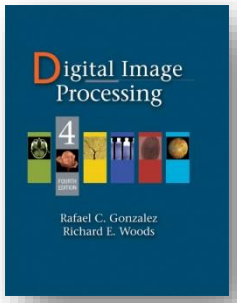
Chapter 1

Introduction

第一章 绪论

One picture is worth more than ten thousand words.

Anonymous

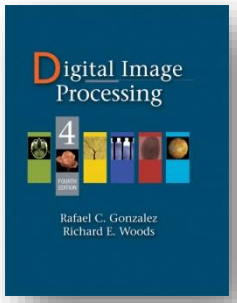


Chapter 1

Introduction

本章目标：

- 了解数字图像的概念；
- 了解数字图像处理领域的历史；
- 定义图像处理的定义和范围；
- 了解应用数字图像处理方法的不同领域；
- 熟悉图像处理基本过程；
- 概述通用图像处理系统的组成；
- 了解数字图像处理领域的文献。



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1.1 什么是数字图像处理

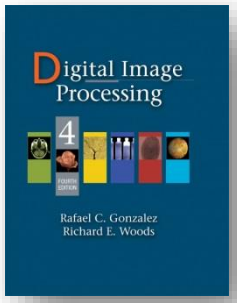
1.2 数字图像处理的起源

1.3 数字图像处理技术应用领域的实例

1.4 数字图像处理中的基本步骤

1.5 图像系统的组成

1.6 小结



Chapter 1
Introduction

- 图像，可看成是空间各个坐标点上的光强度的集合

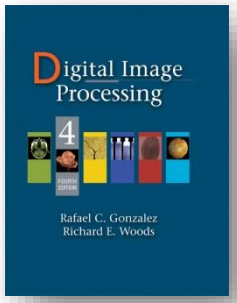
2-D数组 $f(x, y)$

x, y：2-D空间XY中坐标点的位置

f：代表图像在(x, y)的性质F 的数值

性质F：可对应不同物理量

灰度图像里用灰度表示，彩色图像就是R、G、B 值



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Introduction

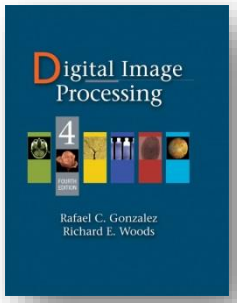
2-D数字图像表示

x，y和f为有限的离散数值

$$I = f(x,y) = \begin{bmatrix} i_{0,0} & i_{0,1} & \cdots & i_{0,N-1} \\ i_{1,0} & i_{1,1} & \cdots & i_{1,N-1} \\ \vdots & \vdots & \vdots & \vdots \\ i_{M-1,0} & i_{M-1,1} & \cdots & i_{M-1,N-1} \end{bmatrix}_{M \times N}$$

像素或像元的属性：空间位置和灰度。

数字图像处理：借助计算机处理数字图像。



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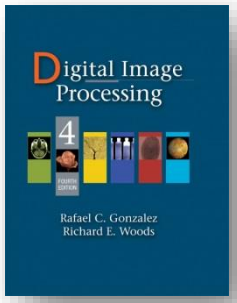
图像单元

一幅图像是许多图像单元的集合体

2-D图象： 像素（picture element）常用pixel表示

3-D图象： 体素（volume element）常用voxel表示

$$f(x, y) \rightarrow f(x, y, z),\ f(x, y, t)$$



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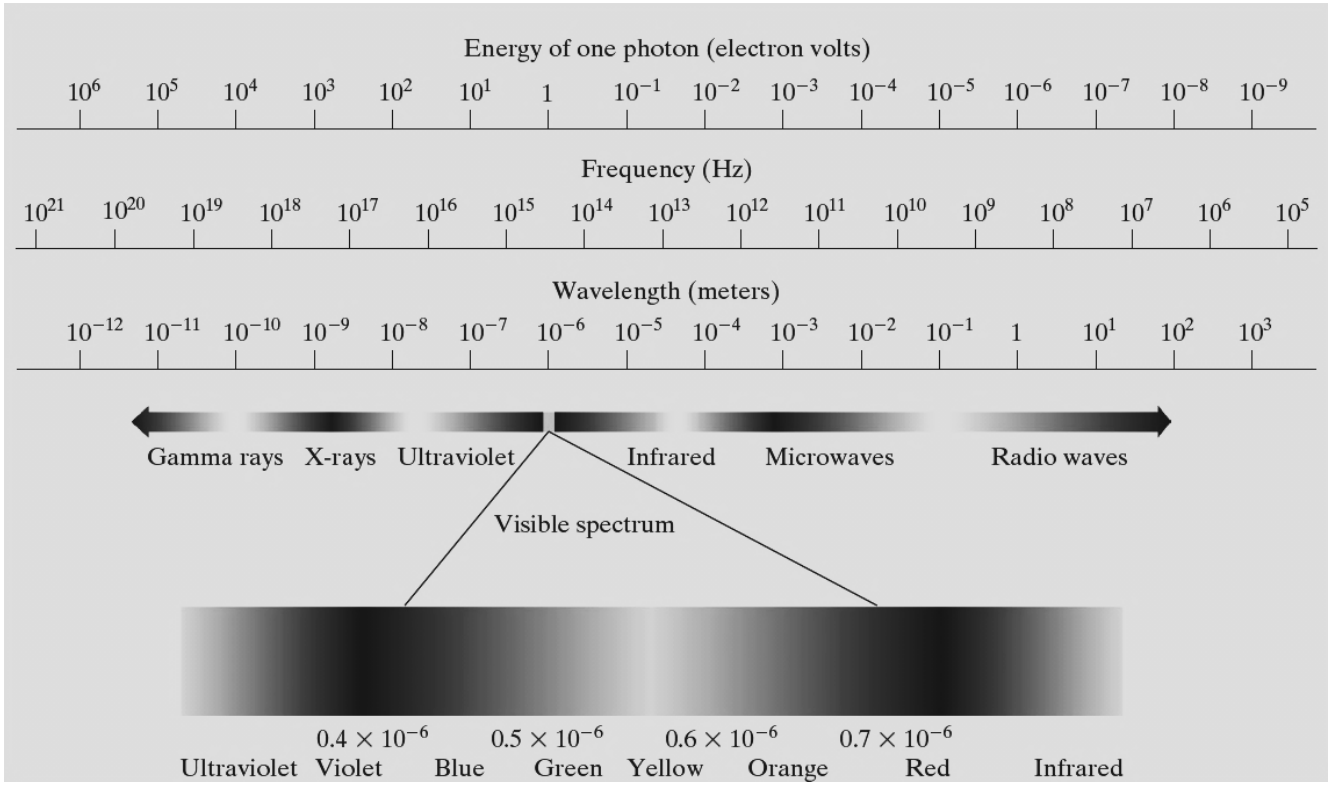
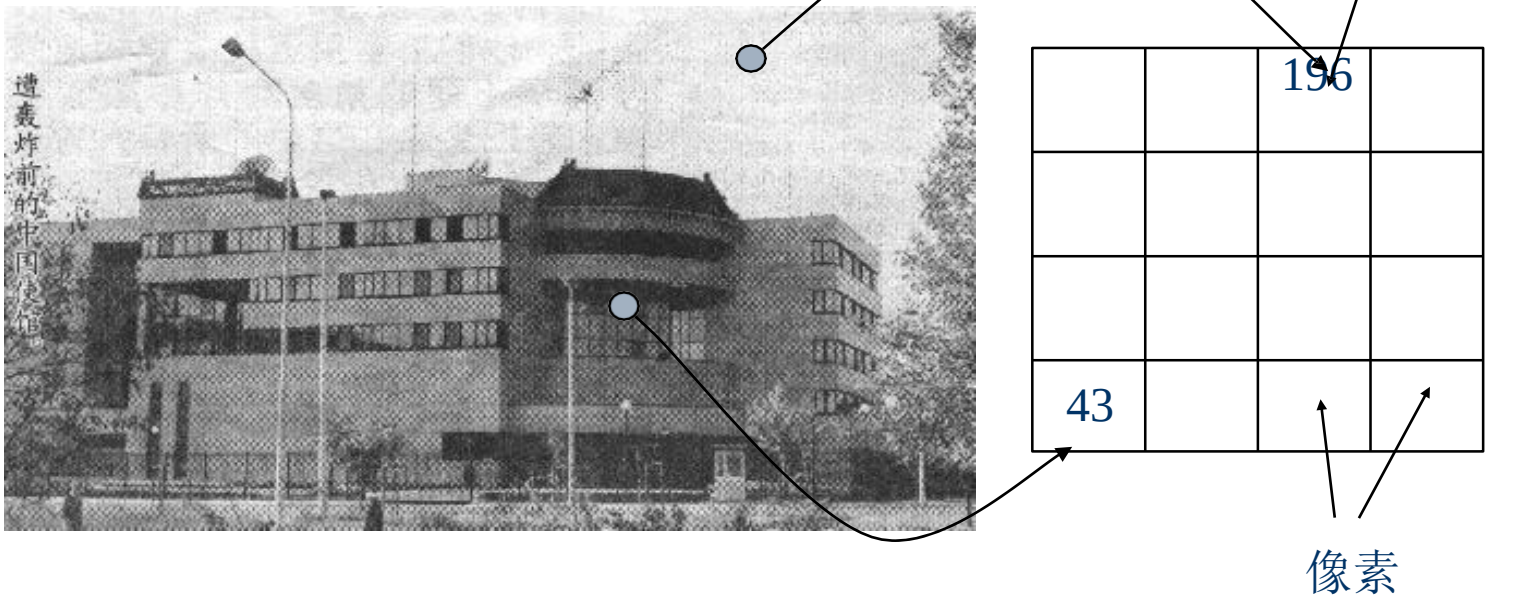
图像显示



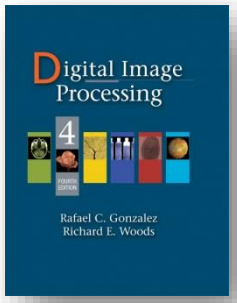
- 人类感知可见光波段，成像机器感知从伽马到长波
- 数字图像处理涉及面很宽泛

Chapter 1
Introduction

图像显示示例



（a）物理图像　　（b）数字图像



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数字图像处理的定义

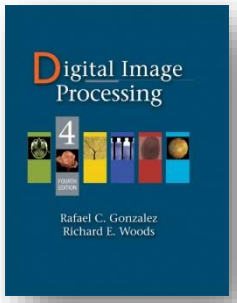
从图像处理到计算机视觉是一个连续的统一体

图像处理（图像 ➡ 图像）

图像分析（图像 ➡ 数据）

图像理解（图像 ➡ 知识）

我们将**数字图像处理**界定为其输入和输出都是图像的处理



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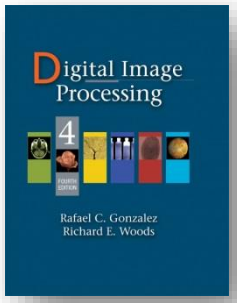
简单的点运算（低级处理）

去除噪声（低级处理）

Degraded Image　　Noise reduced Image



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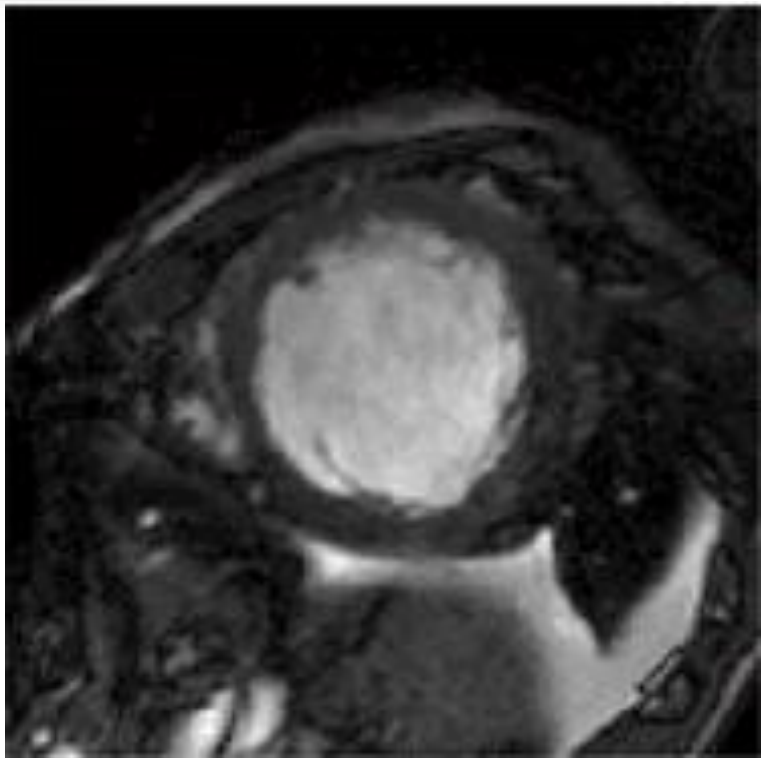
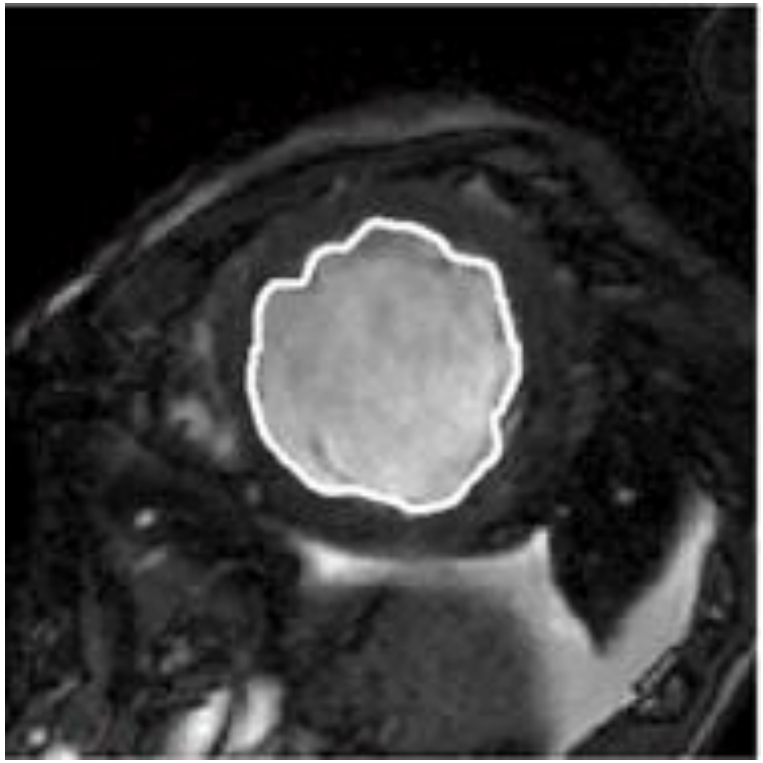
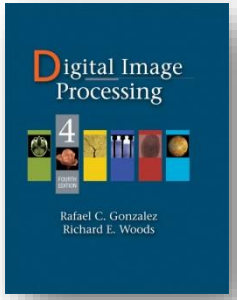




图像分割（中级处理） → 心腔容积的大小



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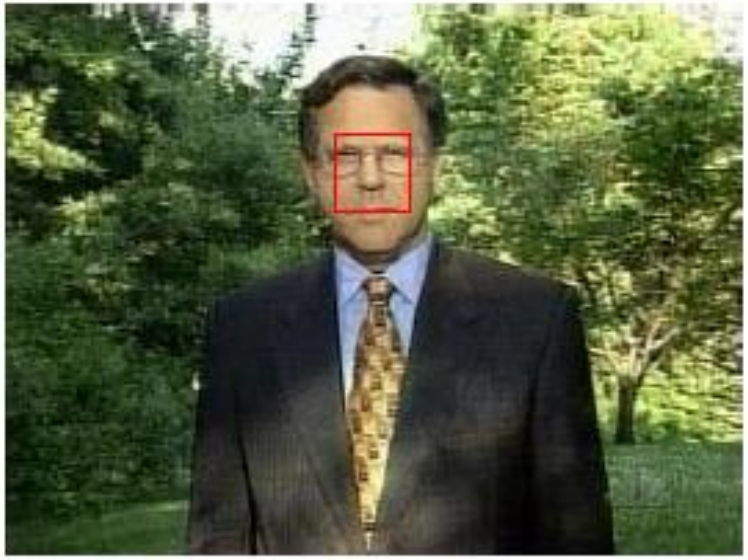
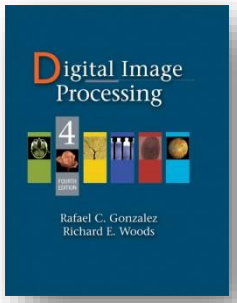


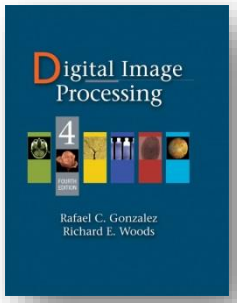
人脸跟踪与识别（高级处理）



Chapter 1
Introduction

本课程数字图像处理讨论的内容

- 低级图像处理：图像->图像，增强、滤波、变化等
- 中级图像处理：特征提取和目标识别
- 高级图像处理：获取-预处理-提取-识别-理解



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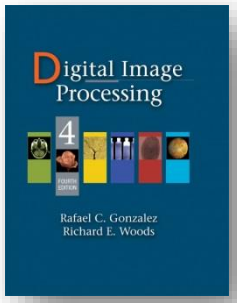
1.6 小结



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Chapter 1
Introduction

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

1921年 电报打印机采用
特殊字符在编码纸带打印。
输出设备从通用到专用

1922年 两次穿越大西洋，
穿孔纸得到图像检测误差。
图像通信系统
信源编码和信道编码

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

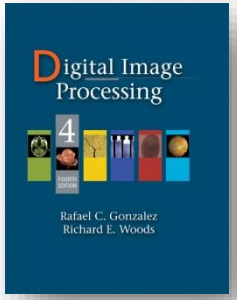

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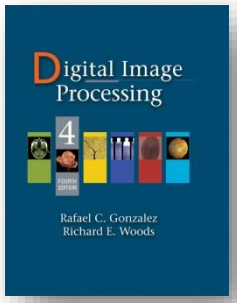
FIGURE 1.3 Unretouched cable picture of Generals Pershing and Foch, transmitted in 1929 from London to New York by 15-tone equipment. (McFarlane.)

1929年 从伦敦到纽约
从早期5个灰度到15个
通过电缆传输



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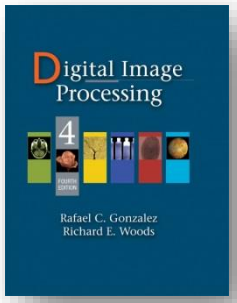
- 1948年贝尔实验室发明晶体管
- 20世纪50年代和60年代COBOL和FORTRAN的开发
- 1958年发明了集成电路
- 20世纪早期操作系统的开发
- 20世纪70年代Intel开发了微处理器
- 1981年IBM推出个人计算机
- 元器件逐步小型化

以上为数字图像的两个基本需求—大容量存储、显示系统奠定基础



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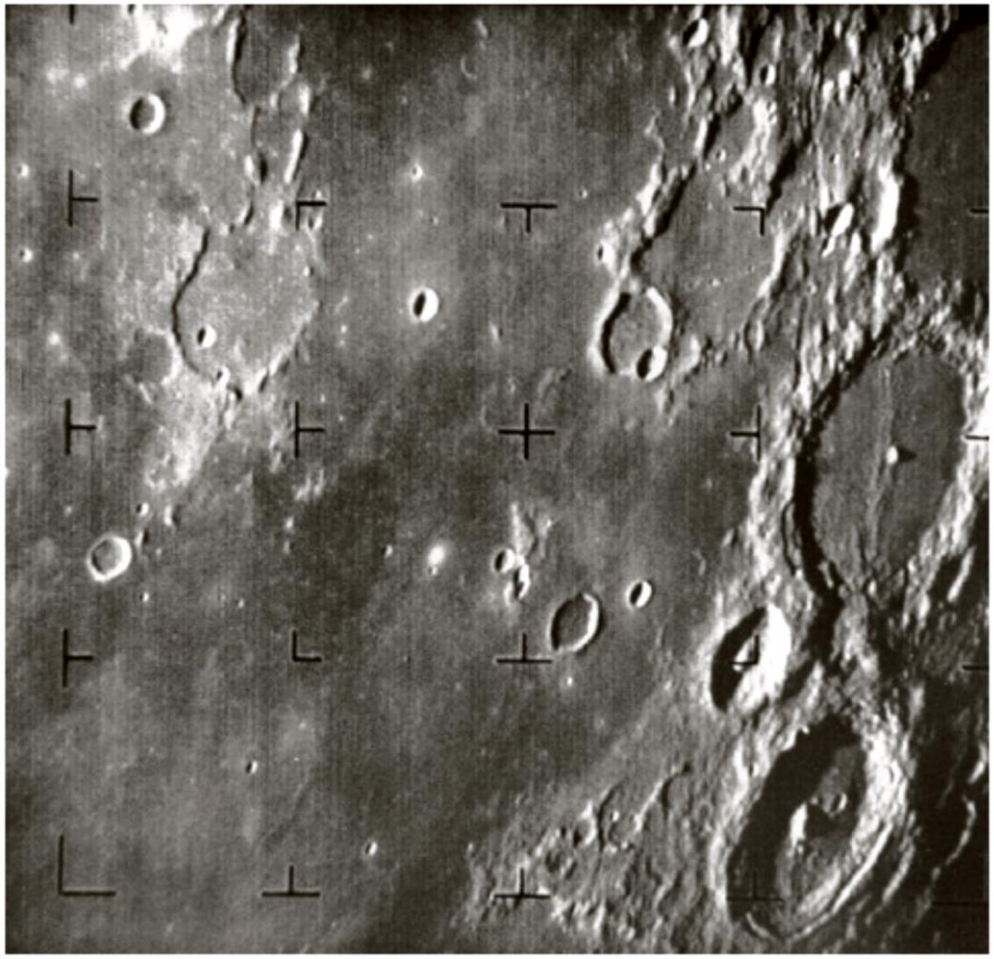
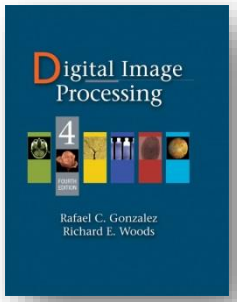


FIGURE 1.4 The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9 : 09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

数字图像处理的诞生是大型计算机的使用和空间项目的开发



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1.2 数字图像处理的起源

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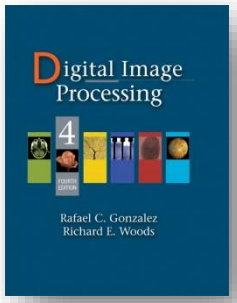
1.4 数字图像处理中的基本步骤

1.5 图像系统的组成

1.6 小结



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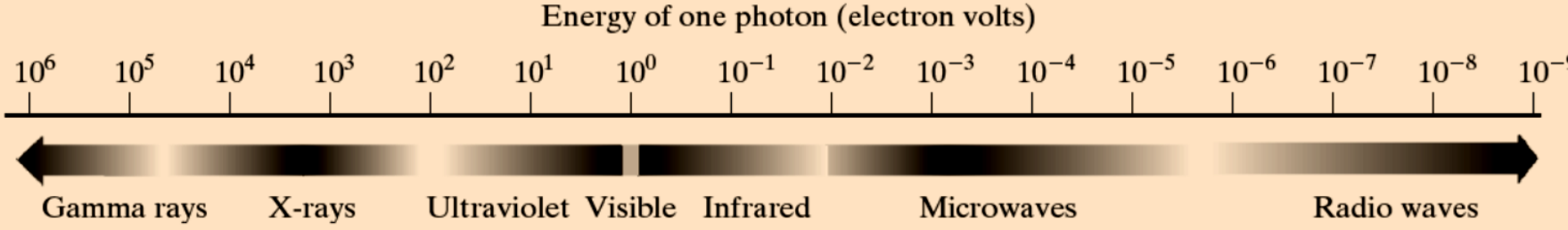
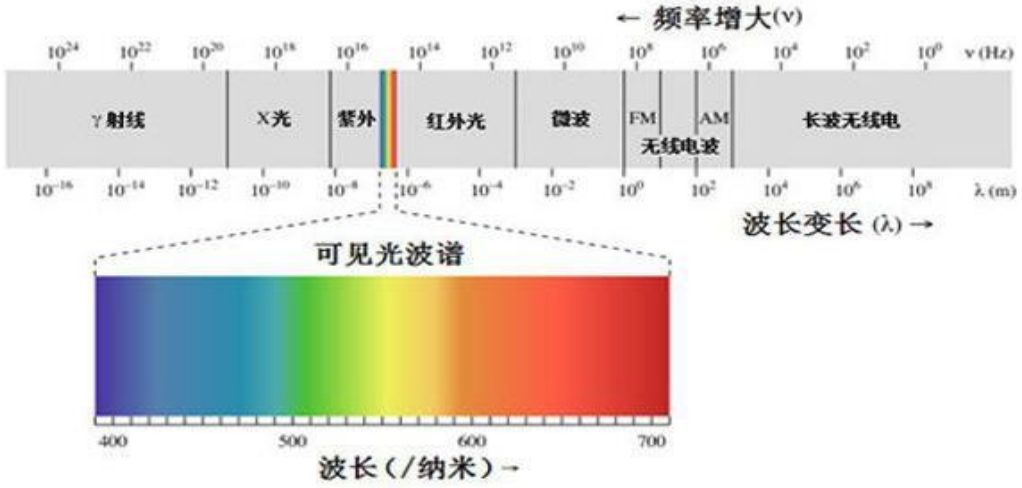
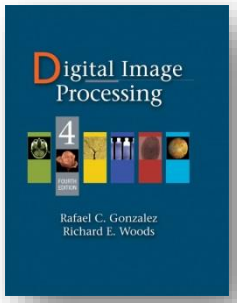


FIGURE 1.5 The electromagnetic spectrum arranged according to energy per photon.

图像媒介电磁波、声波、超声波、电子





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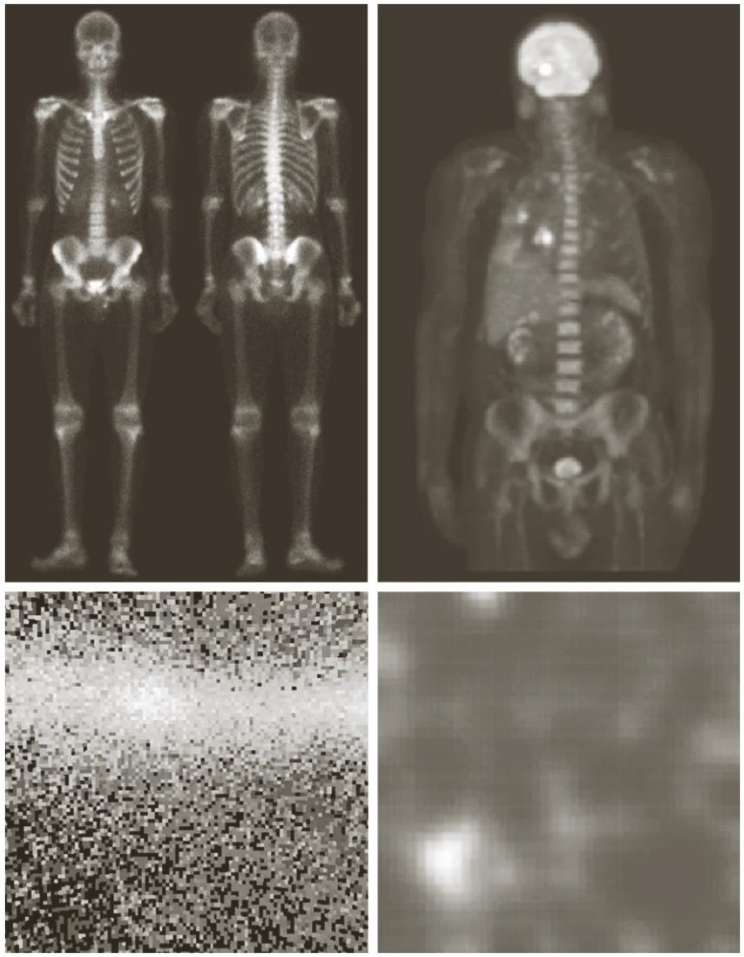
伽马射线成像

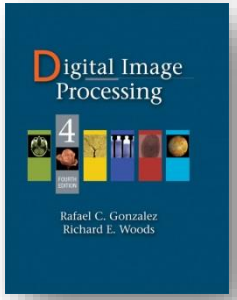
(a) 骨骼扫描图像

(b) PET图像

(c) 天鹅星座环图像

(d) 来自反应堆真空管 的伽马辐射（亮点）





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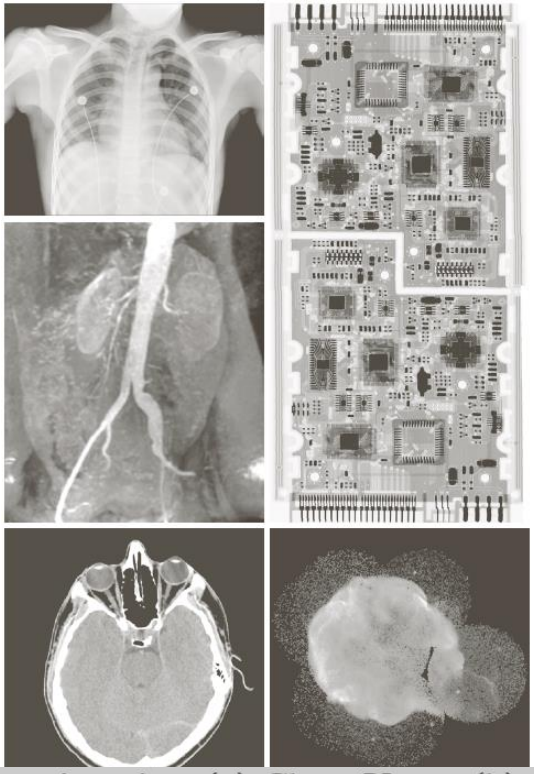
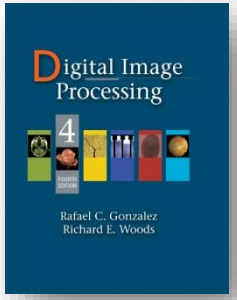
X射线成像

X射线是最早用于
成像 的电磁辐射源之一



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.)



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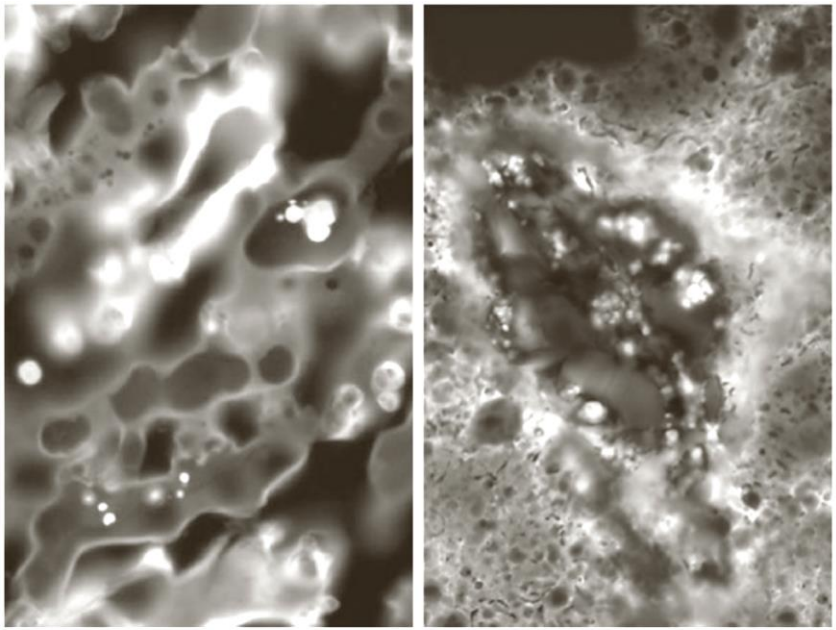
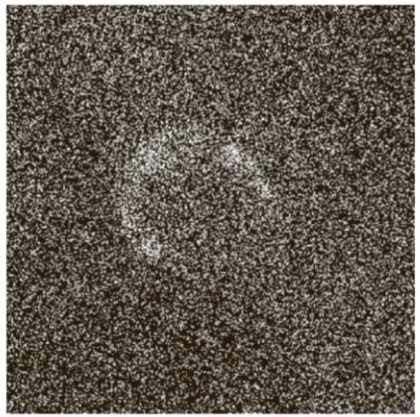
紫外波段成像

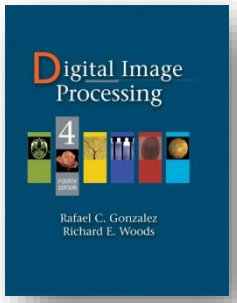




（a） 普通玉米图像；
（b） 患黑穗病的玉米图像；
（c） 天鹅星座环图像

b
c

GURE 1.8
xamples of
ltraviolet
naging.
) Normal corn.
) Smut corn.
) Cygnus Loop.
mages courtesy
f (a) and
) Dr. Michael
. Davidson,
lorida State
niversity,
) NASA.)



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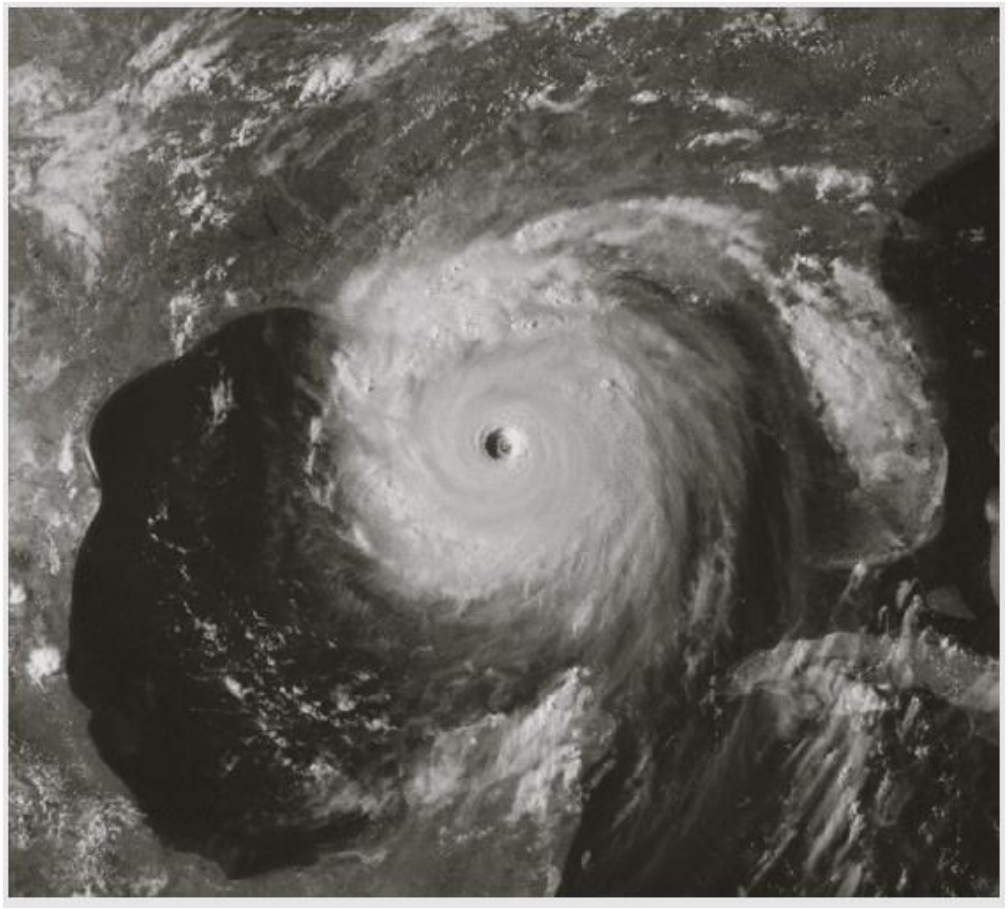

FIGURE 1.11 Satellite image of Hurricane Katrina taken on August 29, 2005. (Courtesy of NOAA.)

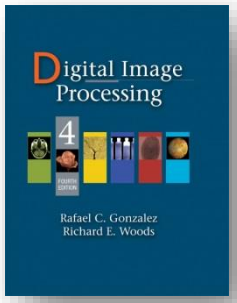

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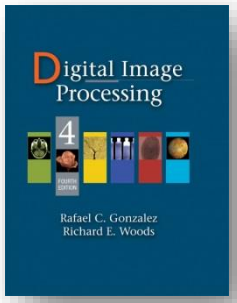
FIGURE 1.12 Infrared satellite images of the Americas. The small gray map is provided for reference. (Courtesy of NOAA.)



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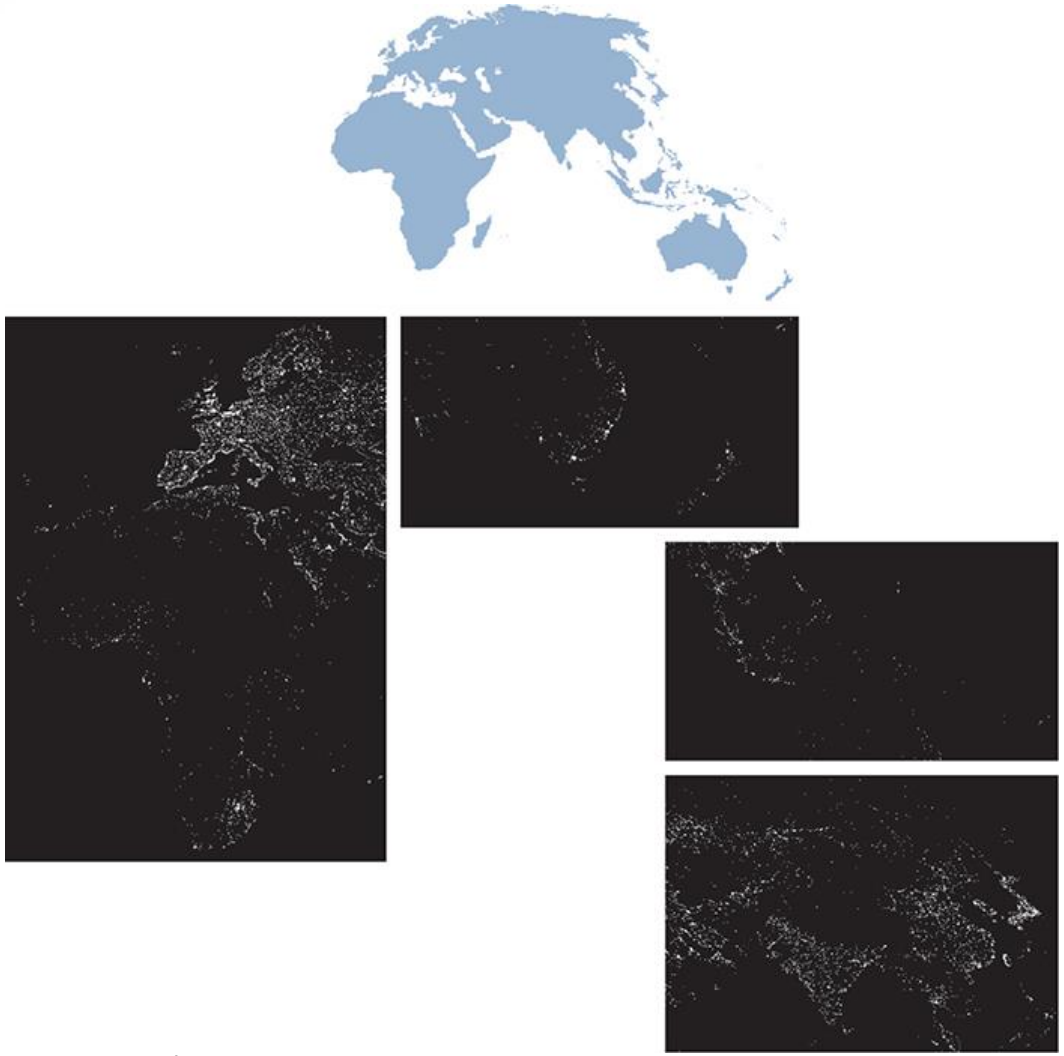

FIGURE 1.13 Infrared satellite images of the remaining populated part of the world. The small gray map is provided for reference. (Courtesy of NOAA.)

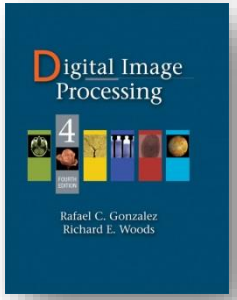

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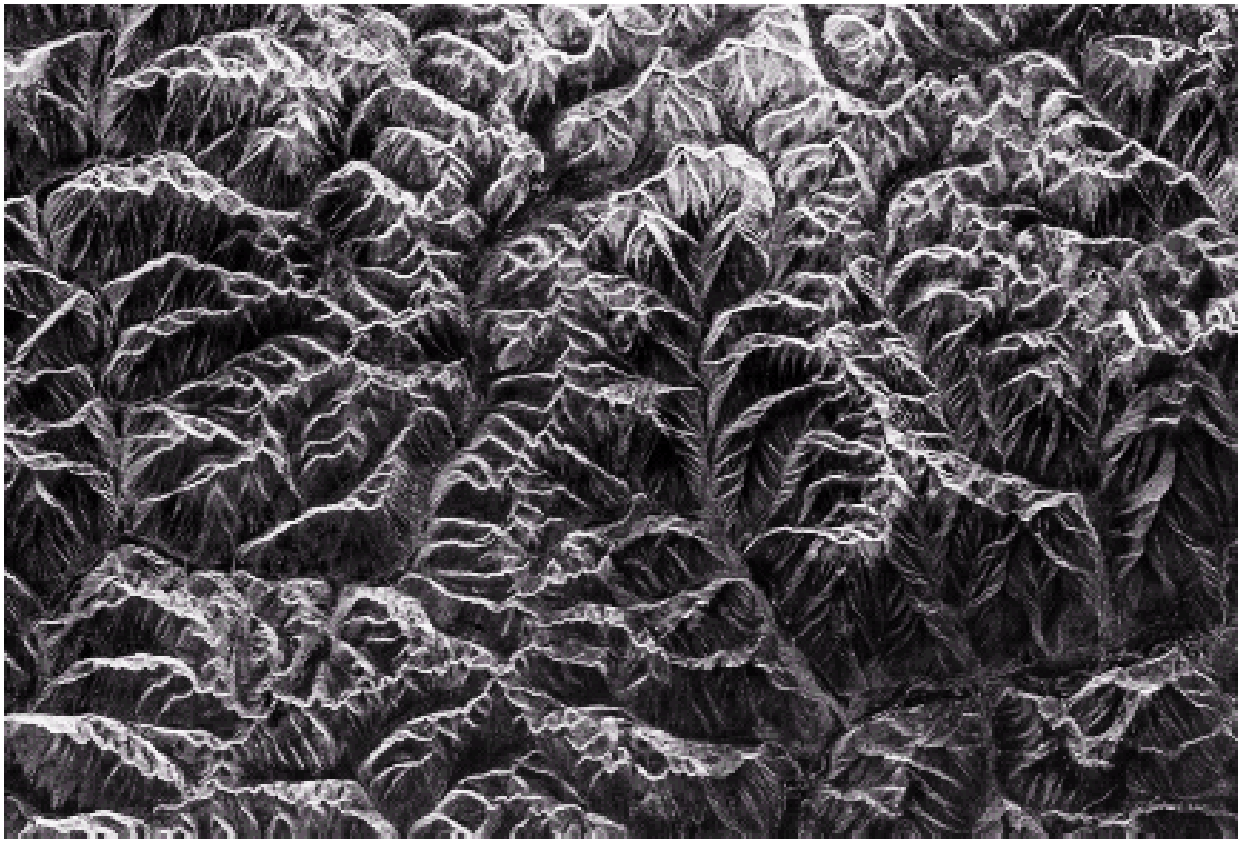
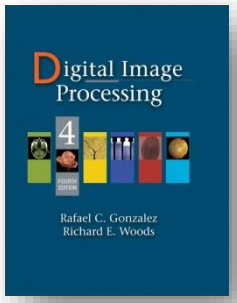
FIGURE 1.16
Spaceborne radar image of mountains in southeast Tibet. (Courtesy of NASA.)



微波波段成像



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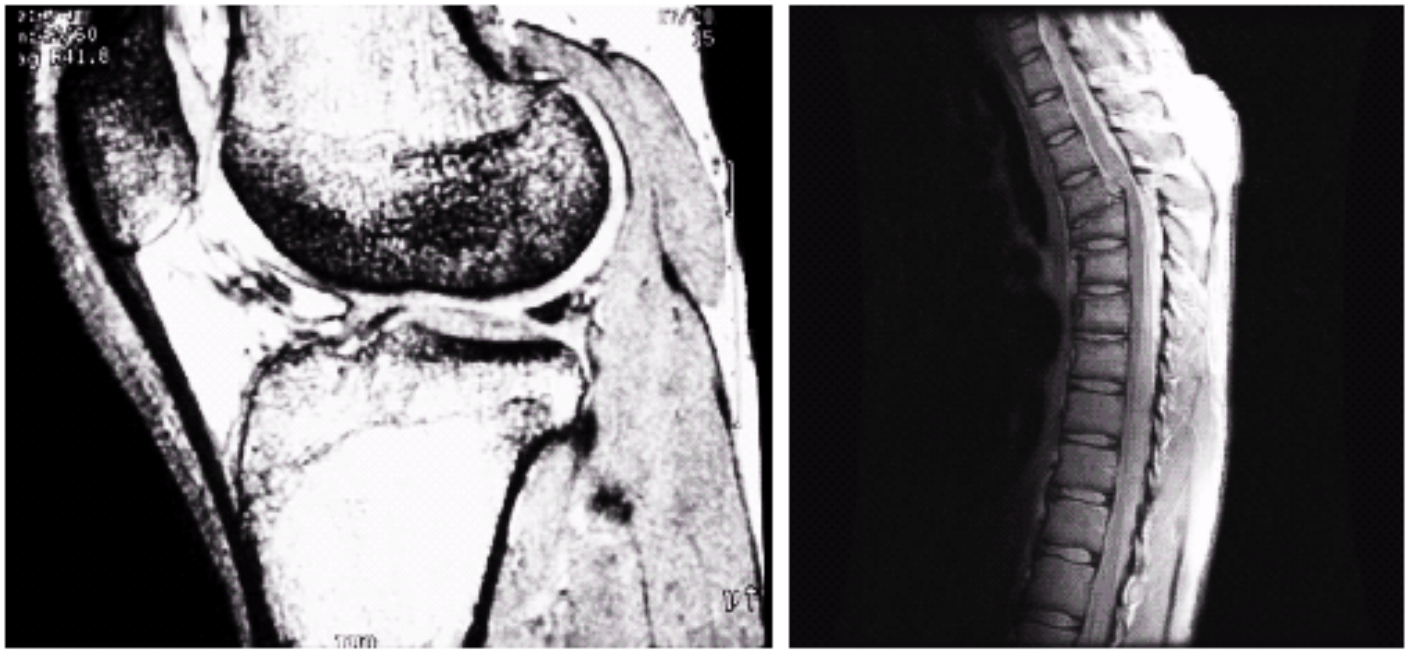
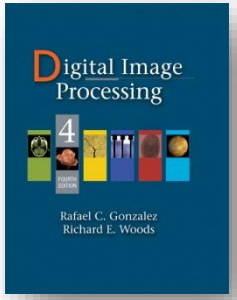
无线电波成像



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.)



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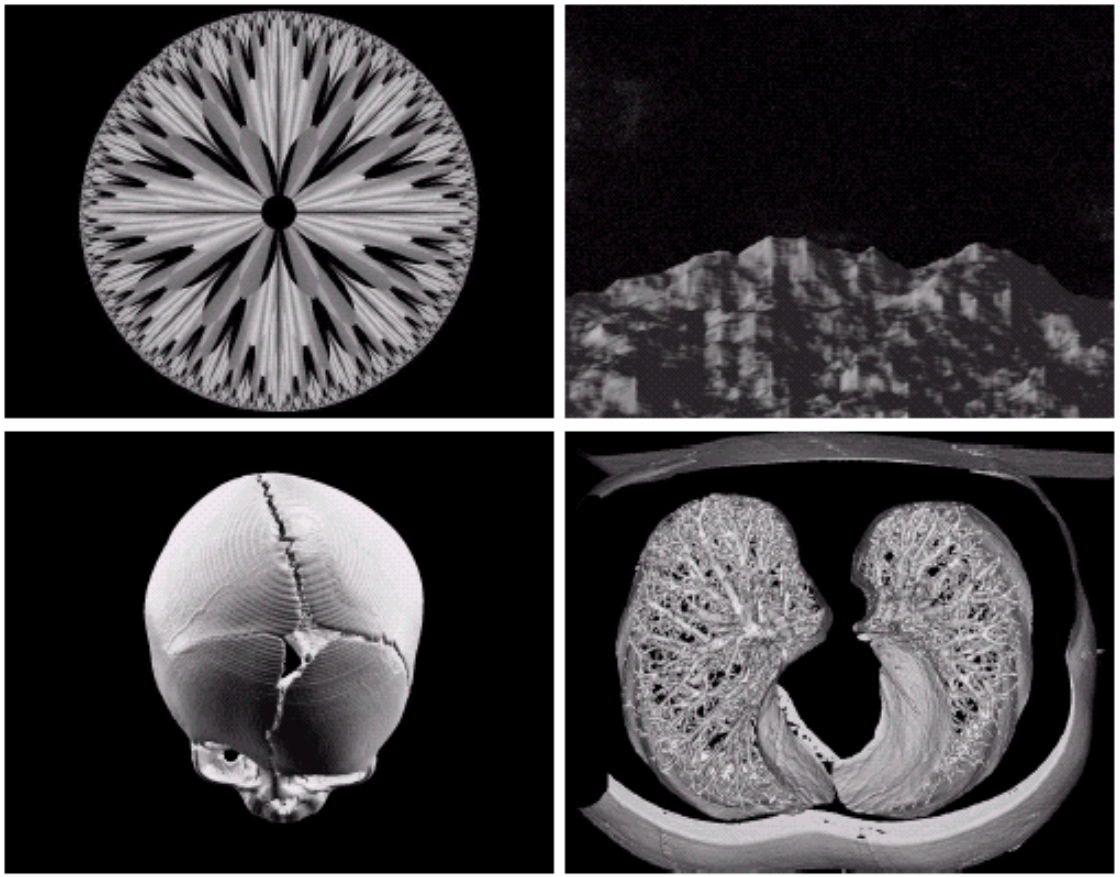
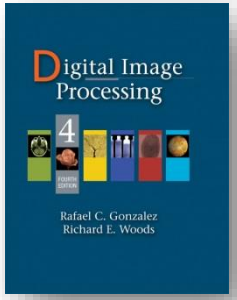


a b
c d

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.)



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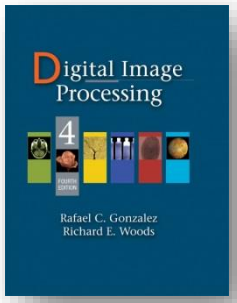
卫星遥感图像分析



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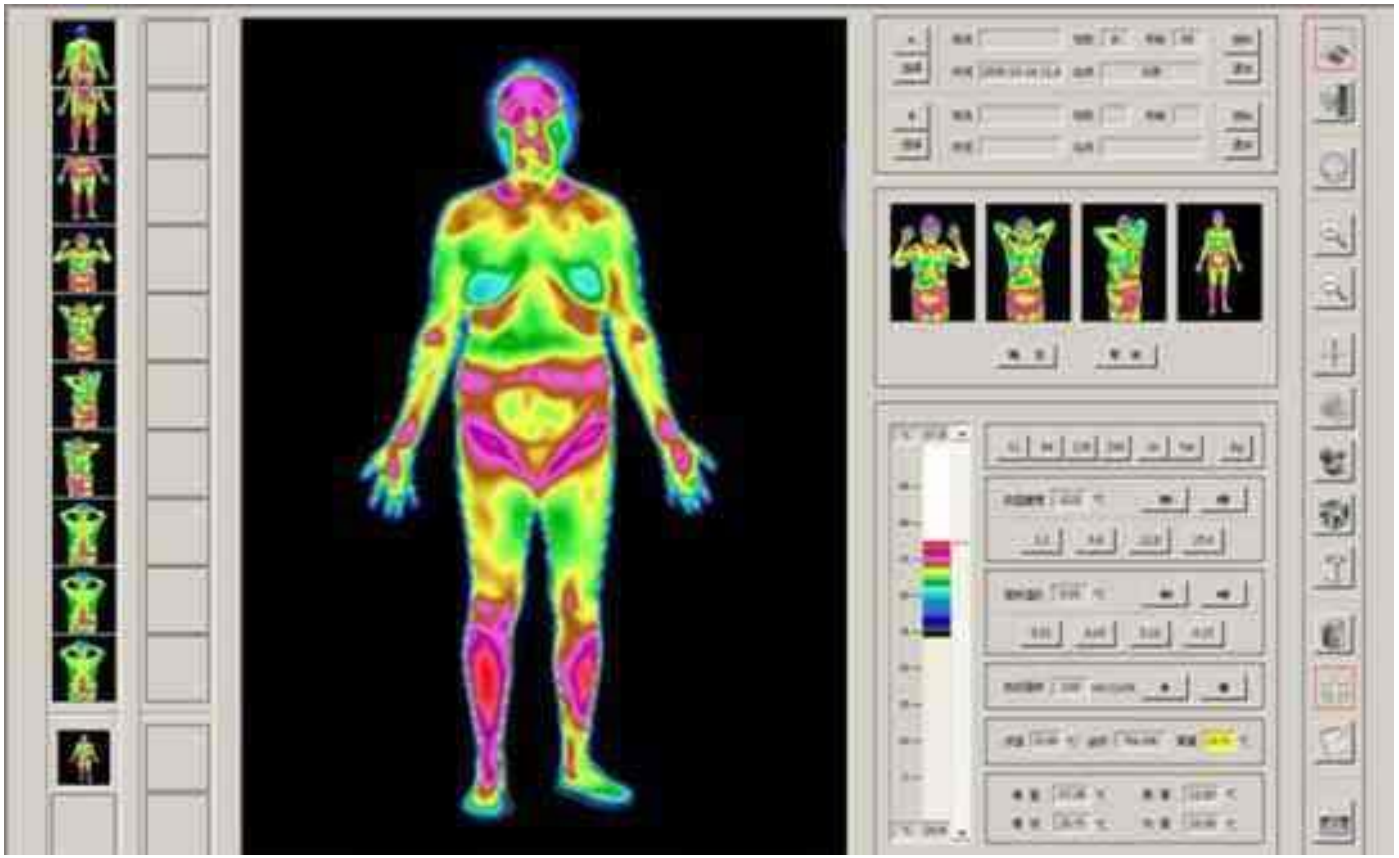
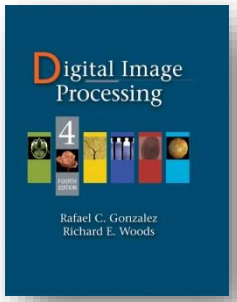
红外波段热成像





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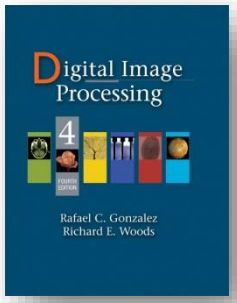
- 计算机生成的图像-基于生成对抗网络(GAN)



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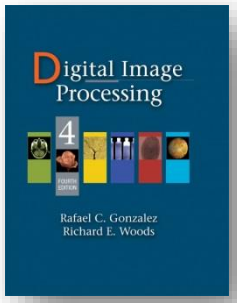
- 美颜相机



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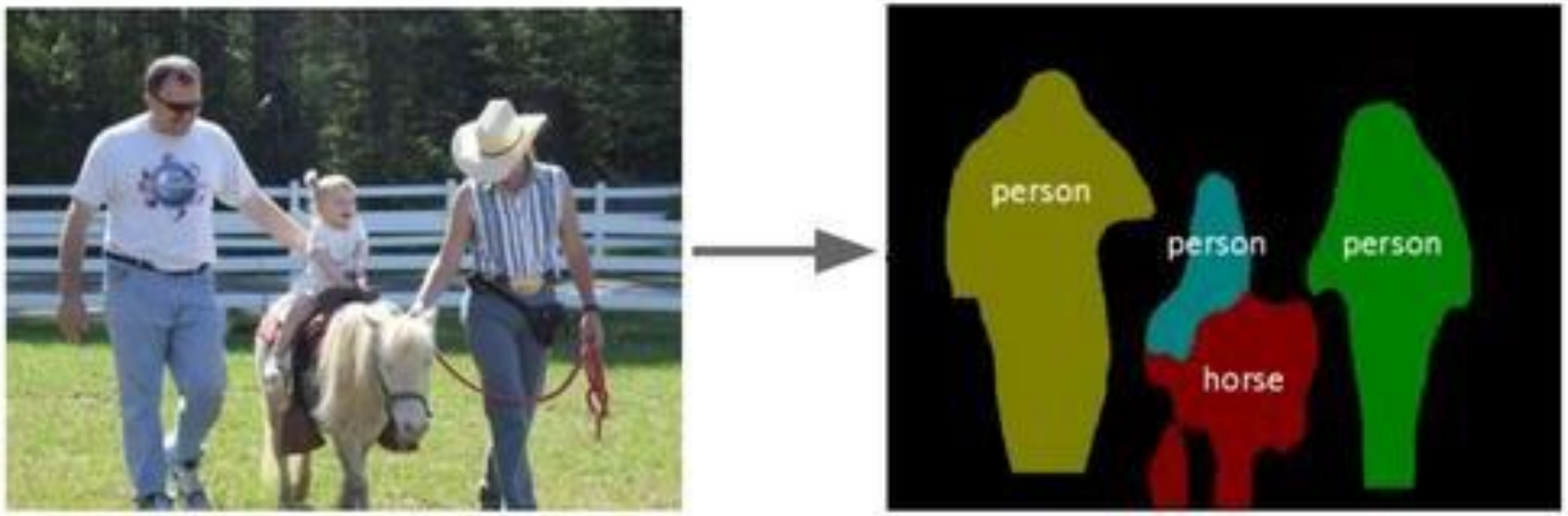
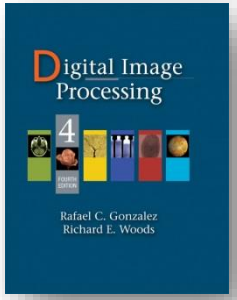
图像分割





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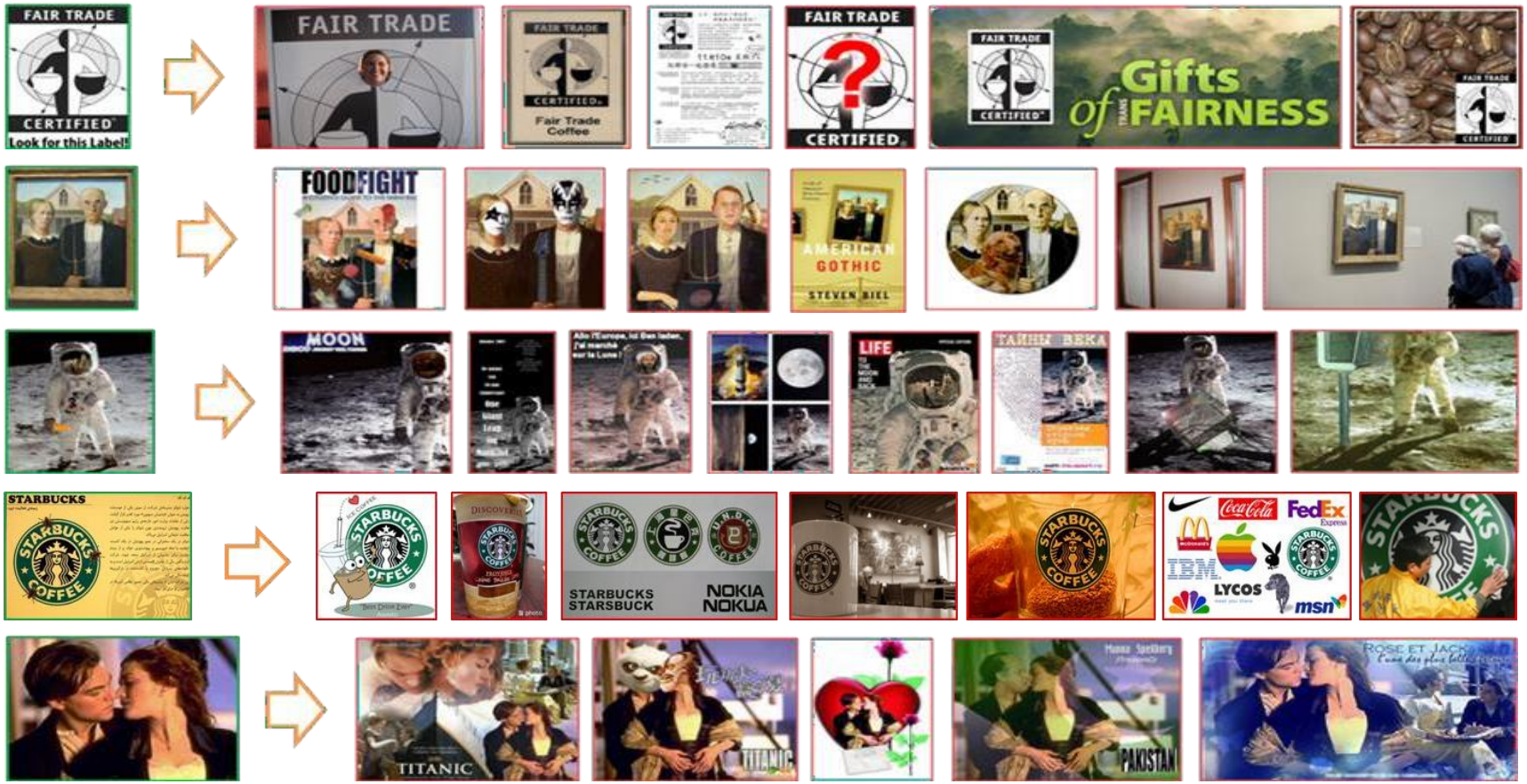
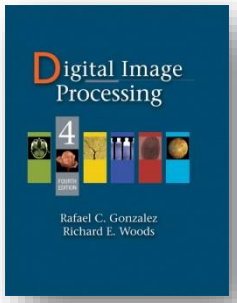
图像检索



Queries (selected from those before the first false positive)



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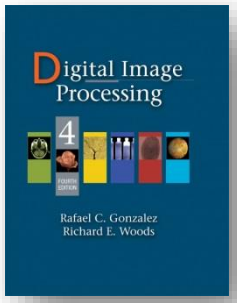

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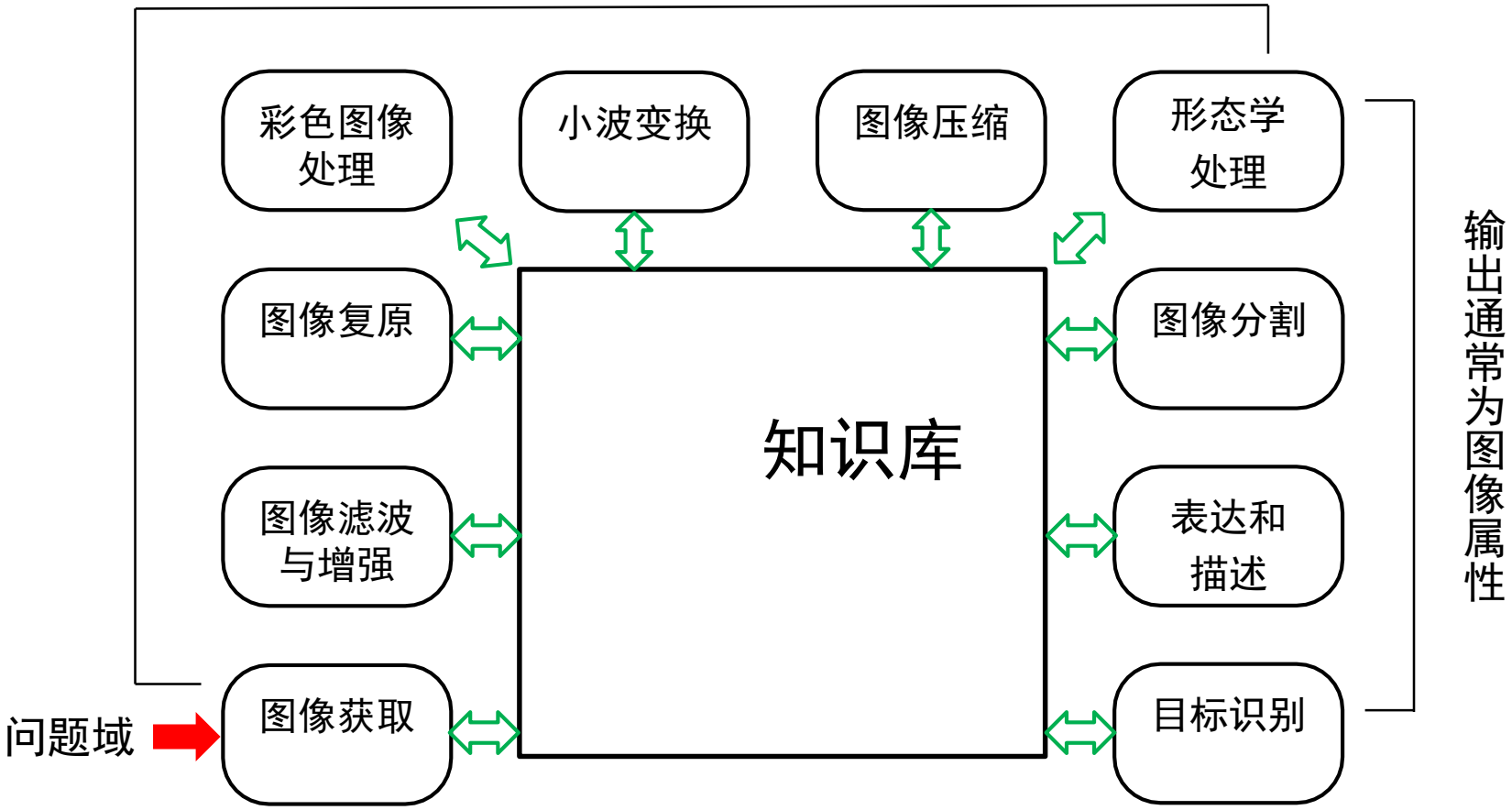
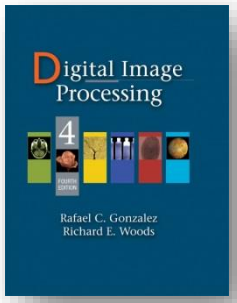
输出通常为图像





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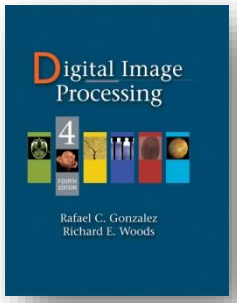
- 图像获取–采样、量化、预处理
- 图像增强–根据需求，对图像进行处理，在特定应用中比原图像更适合进行处理。具有主观性，没有通用理论和方法。
- 图像复原–也是改进图像视觉效果，以图像退化的数学和概率模型为基础，相对客观。
- 彩色图像处理
- 小波–不同分辨率来描述图像的基础。数据压缩、金字塔。
- 压缩–减少图像存储，降低传输带宽
- 形态学–提取图像中用于表示和描述形状成分的工具。
- 图像分割–将图像划分各个组成部分或目标，描述（特征选择），涉及特征提取（特征检测和特征描述）
- 图像模式分类–基于目标特征描述子对目标赋予标志的过程。



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1.1 什么是数字图像处理

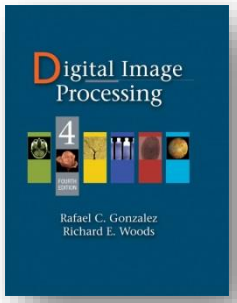
1.2 数字图像处理的起源

1.3 数字图像处理技术应用领域的实例

1.4 数字图像处理中的基本步骤

1.5 图像系统的组成

1.6 小结



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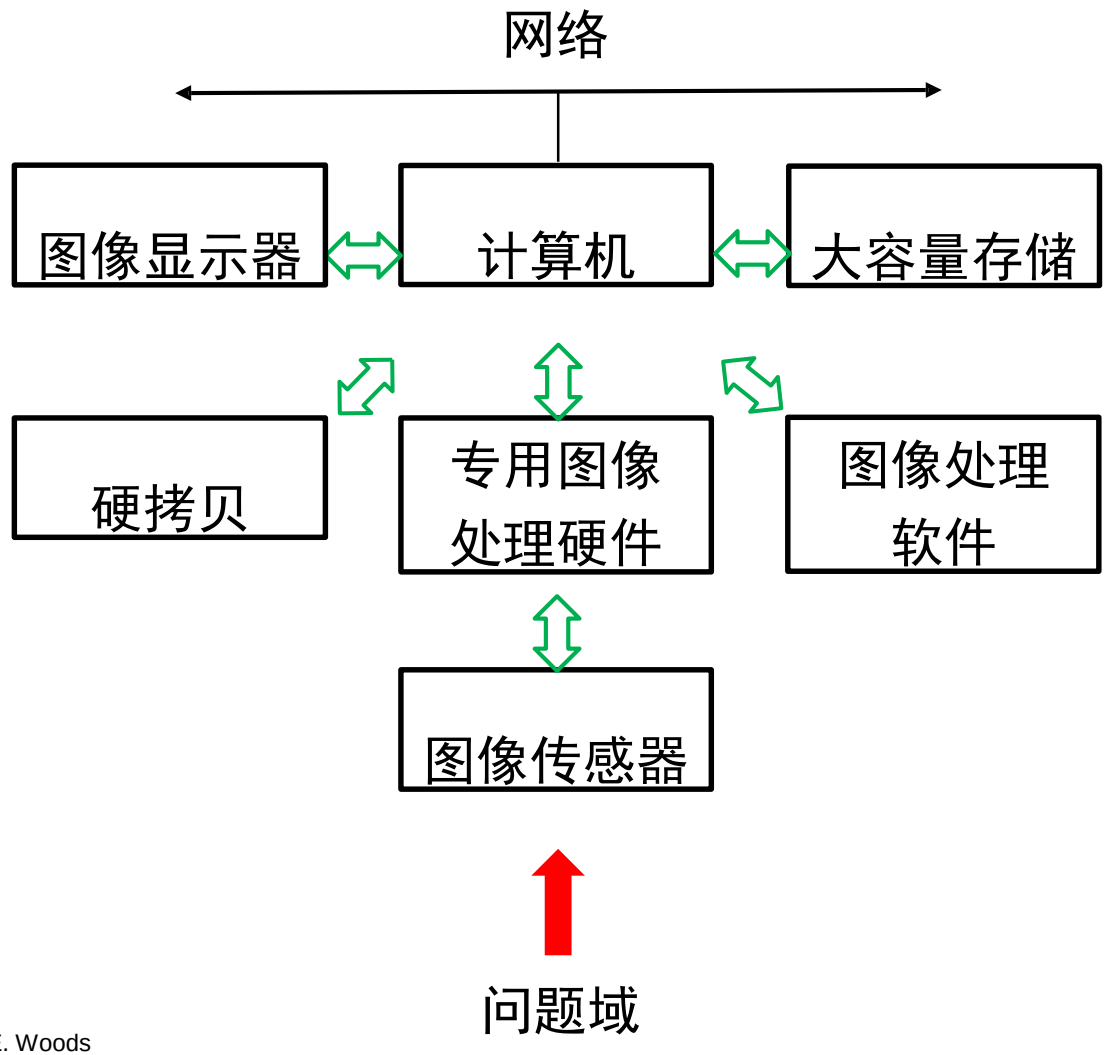

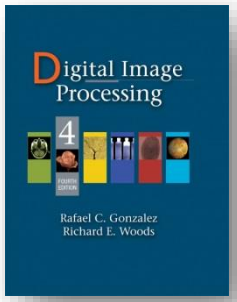

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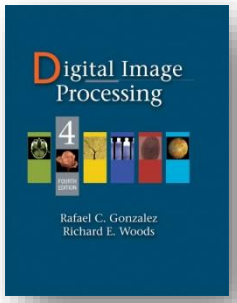

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- **IEEE Transactions on Image Processing**
- **IEEE Transactions on Pattern Analysis and Machine Intelligence**
- **Computer Vision and Image Understanding**
- **Pattern Recognition**
- **Pattern Recognition Letters**
- **Optical Engineering**
- **IEEE Transactions on Information TAheory**
- **IEEE Transactions on Communications**
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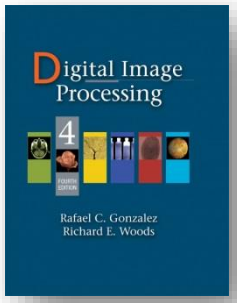
- **IEEE CVPR , ICCV, ECCV, ICIP, BMCV, FGR, ACM MM, …..**



Digital Image Processing, 4rd ed.

Gonzalez & Woods

www.ImageProcessingPlace.com

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图像处理工程师 15-25K·15薪

杭州余杭区五常 | 1-3年 | 本科

岗位职责: 1）根据需求开发ISP/Camera相关功能； 2）负责ISP/Camera图像品质调试和优化，包括3A、HDR、WDR等； 3）编写系统方案、测试

水晶光电

智能硬件 | 已上市 | 1000-9999人

图像处理工程师 20-40K

北京大兴区亦庄 | 3-5年 | 硕士

Job Description Design image processing algorithm, adjust and optimize the param

GE通用电气

医疗设备/器械 | 已上市 | 10000人以上

计算机视觉和图像处理工程师 20-40K·16薪

北京海淀区西北旺 | 3-5年 | 本科

工作职责： 1.基于团队需求，结合业务制定视觉能力研发方案 2.研发深度学习方法，解决基于图像的裁剪、清晰度提升、检测、分类、识别、分割、追踪...

百度

互联网 | 已上市 | 10000人以上