Digital Image Processing

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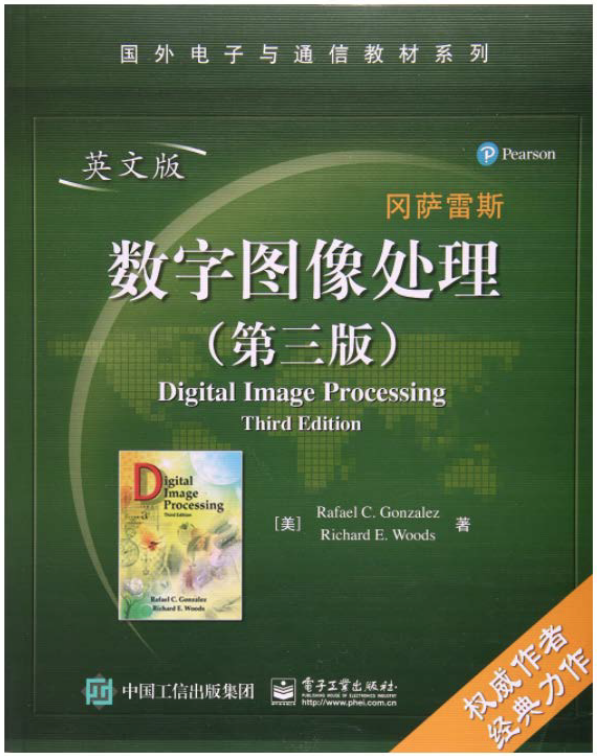
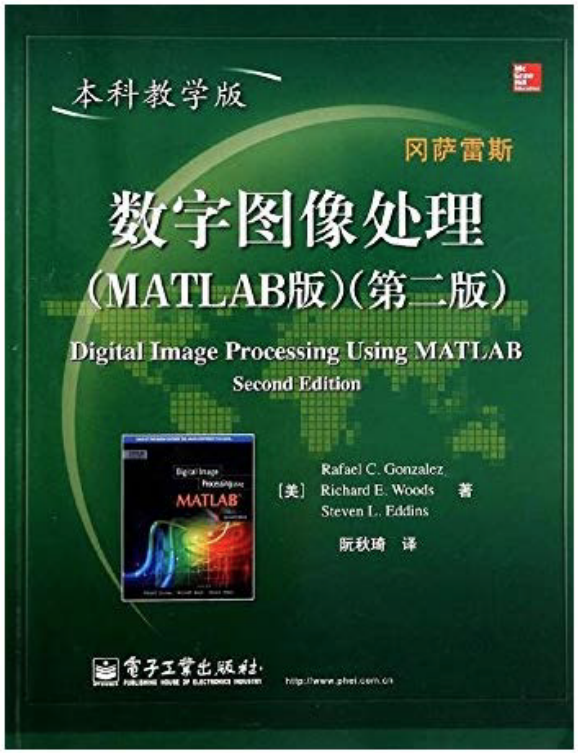
Introduction to the course

Grading

- Homework: 40%
- Project: 40%
- Exam: 20%
- Total: 100%

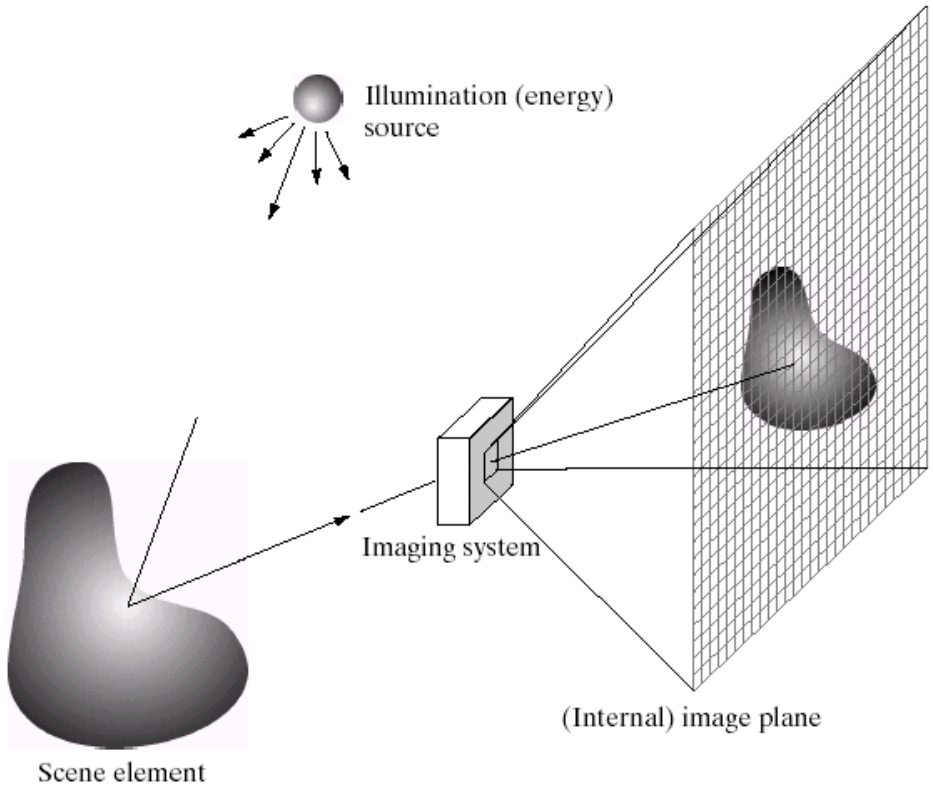
Textbook


国外电子与通信教材系列
英文版
Pearson
冈萨雷斯
数字图像处理
(第三版)
Digital Image Processing
Third Edition
[美] Rafael C. Gonzalez
Richard E. Woods 著
中国工信出版集团
电子工业出版社
http://www.phei.com.cn
权威作者
经典力作


本科教学版
冈萨雷斯
数字图像处理
(MATLAB版)(第二版)
Digital Image Processing Using MATLAB
Second Edition
[美] Rafael C. Gonzalez
Richard E. Woods 著
Steven L. Eddins
阮秋琦 译
电子工业出版社

What is digital image processing?

What is digital image ?



Film

What is digital image ?

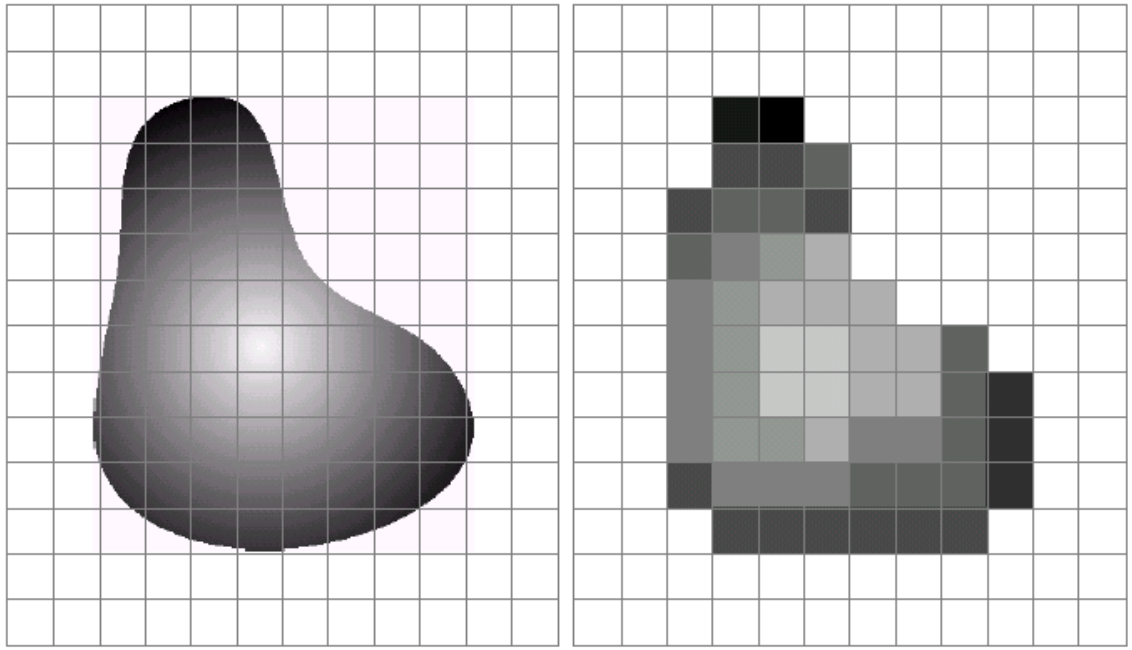
Digital camera

A digital camera replaces film with a sensor array

- Each cell in the array is light-sensitive diode that converts photons to electrons
- Two common types
  - Charge Coupled Device (CCD)
  - CMOS
- http://electronics.howstuffworks.com/digital-camera.htm

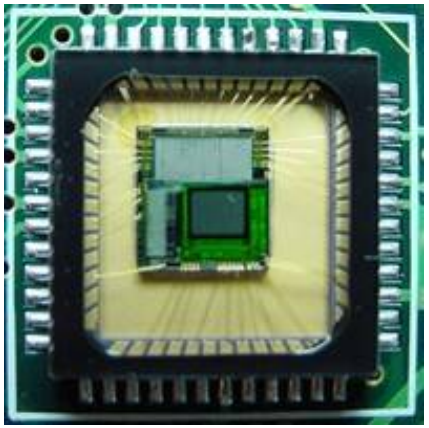
Slide by Steve Seitz

Sensor Array



a b

FIGURE 2.17 (a) Continuos image projected onto a sensor array. (b) Result of image sampling and quantization.



CMOS sensor

The applications of digital image processing

Earth viewers (3D modeling)

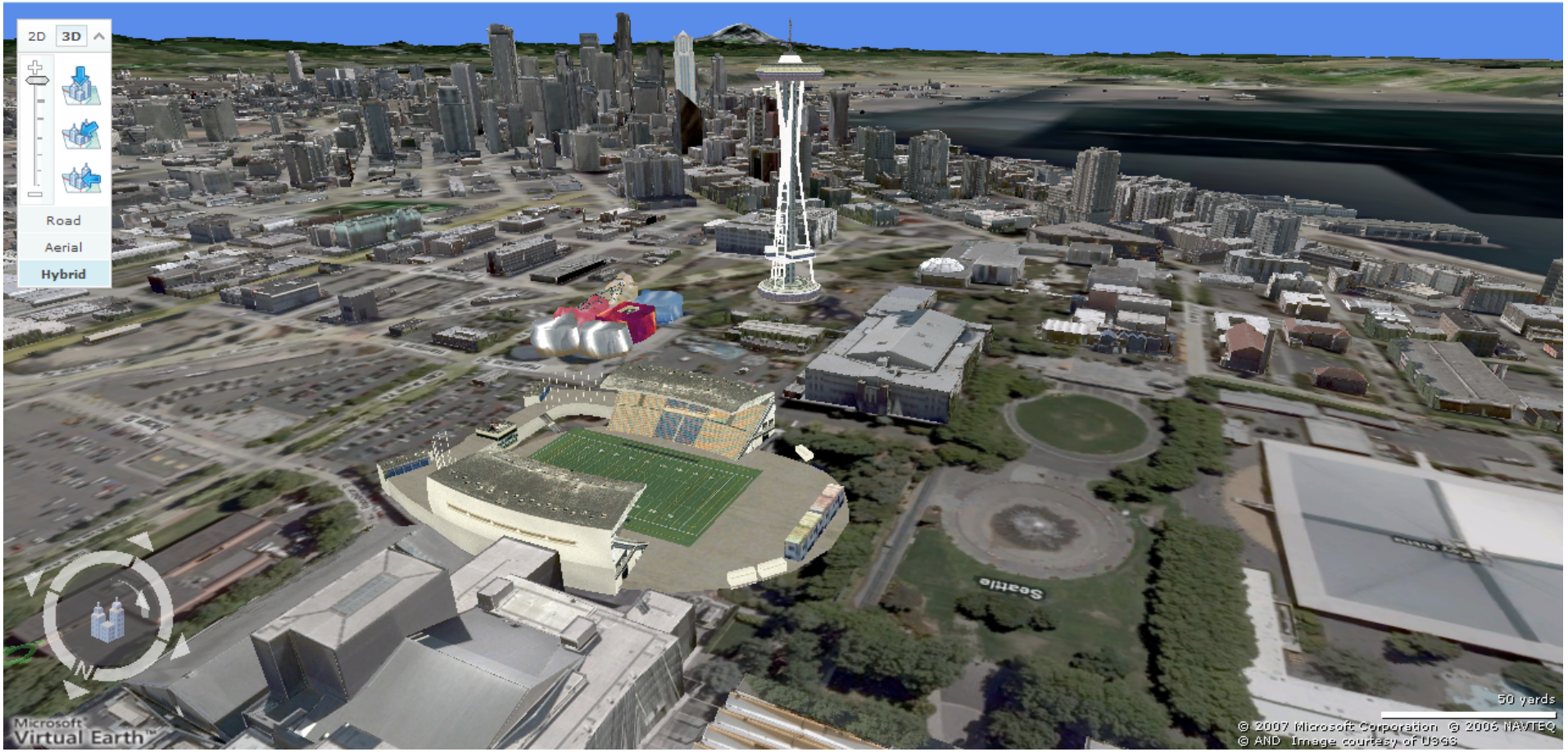
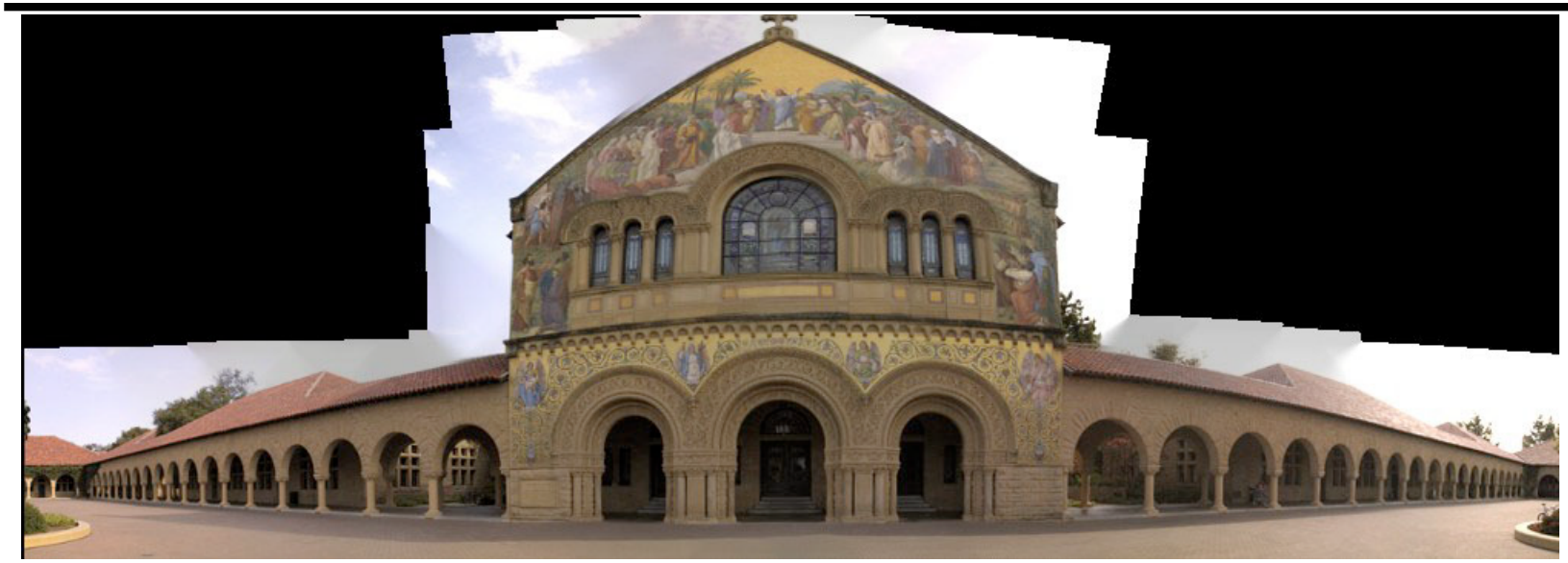


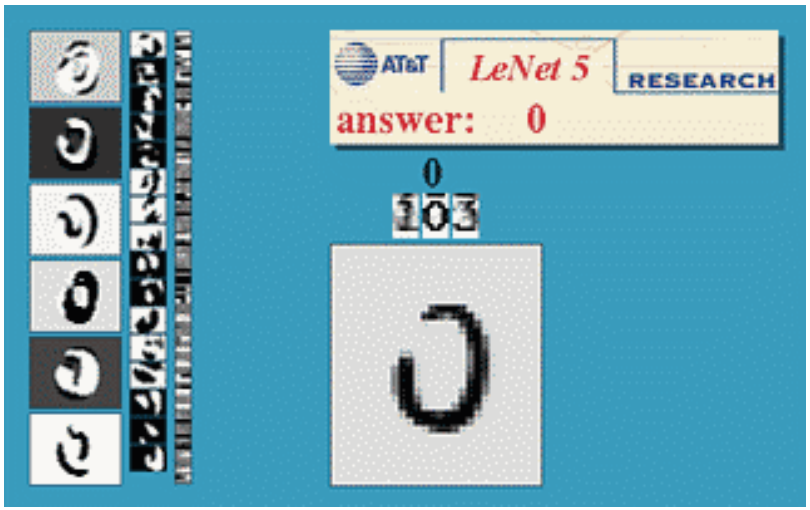
Image from Microsoft's Virtual Earth
(see also: Google Earth)



Optical character recognition (OCR)

Technology to convert scanned docs to text

- If you have a scanner, it probably came with OCR software



Digit recognition, AT&T labs
http://www.research.att.com/~yann/

License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Morphing

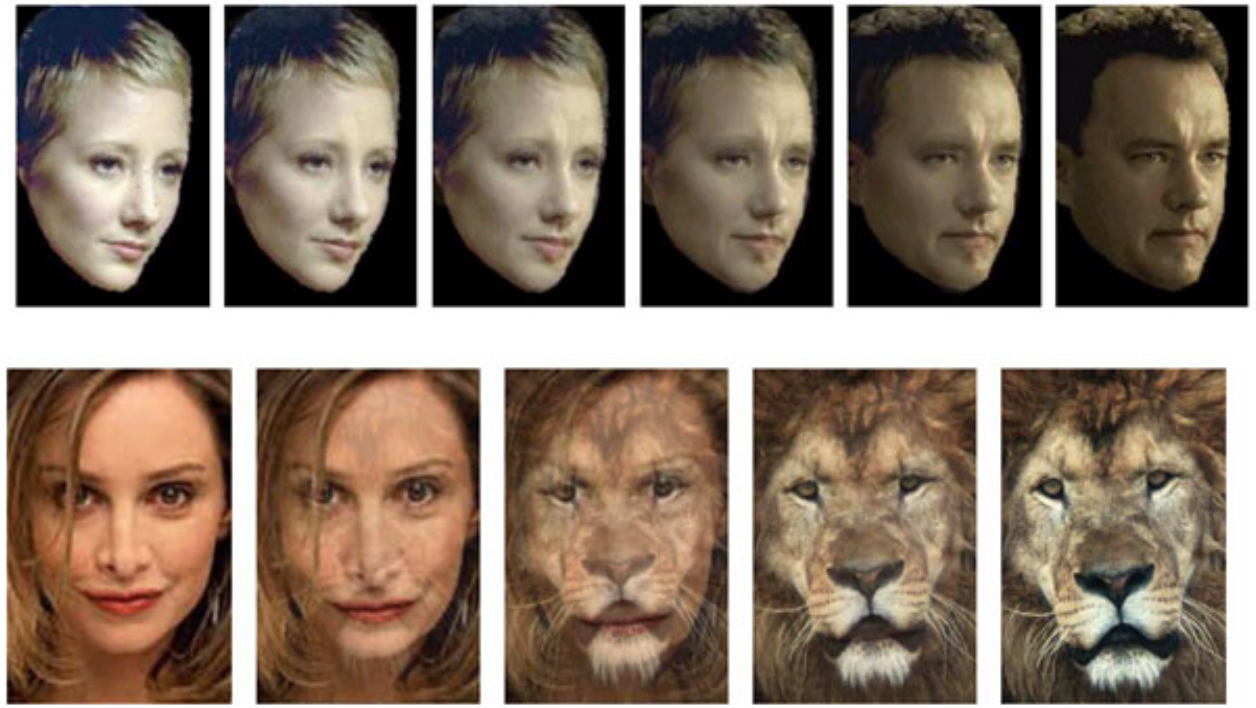
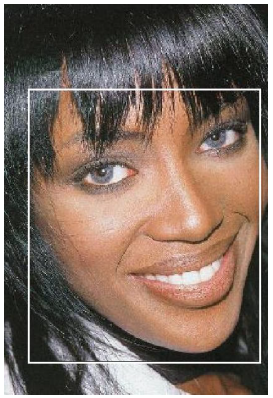
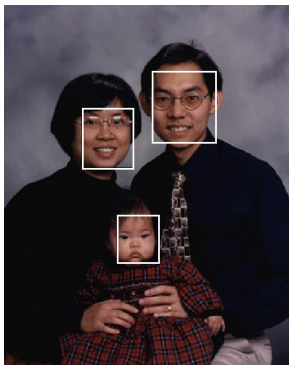
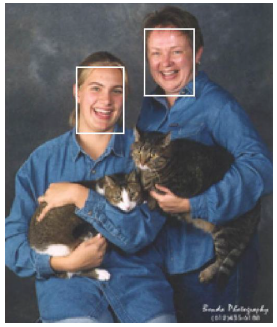


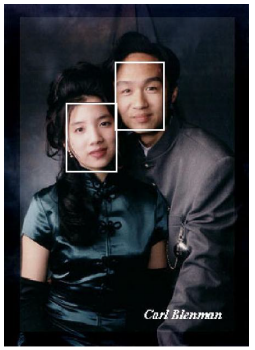
Image Colorization

Face detection

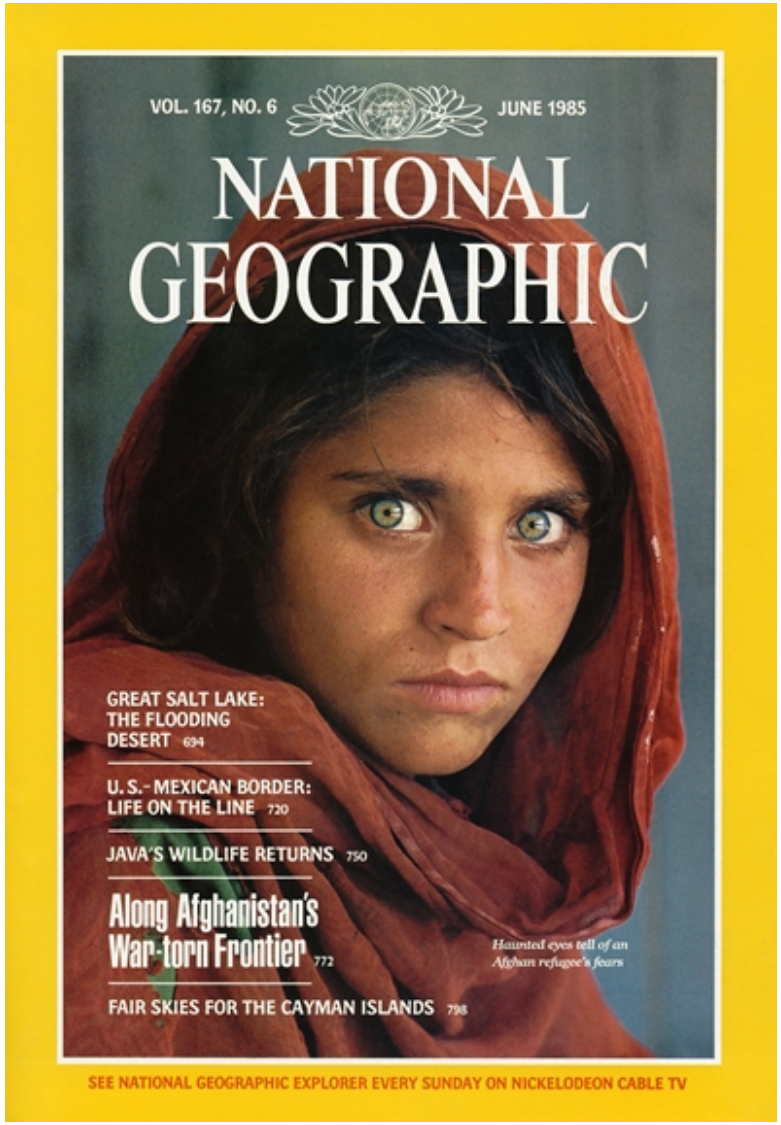








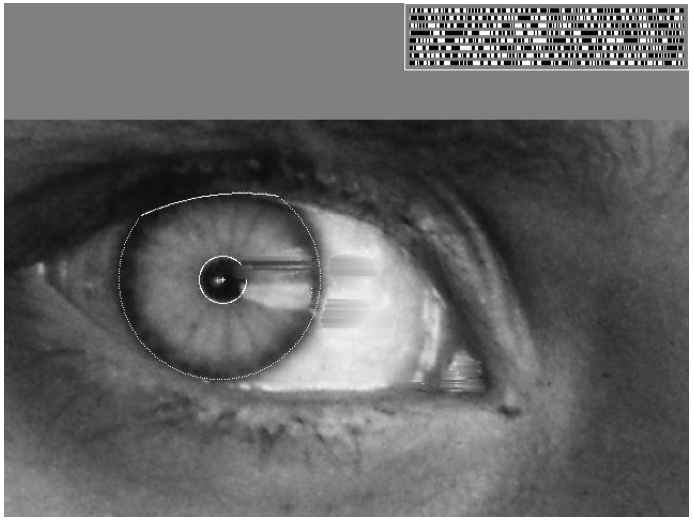
Face recognition

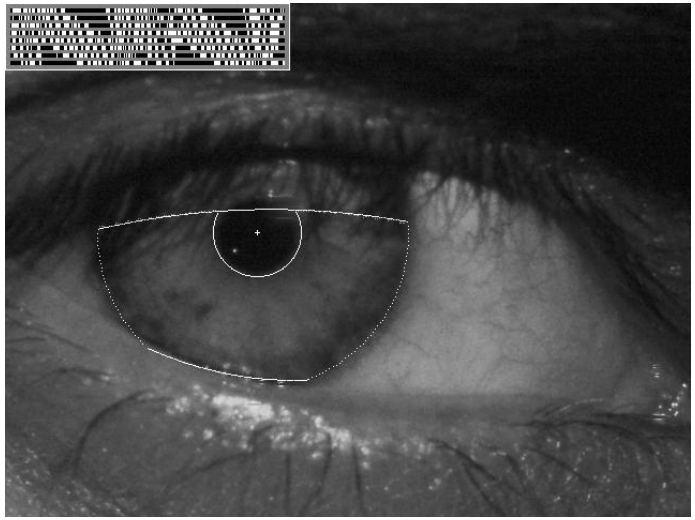


Who is she?

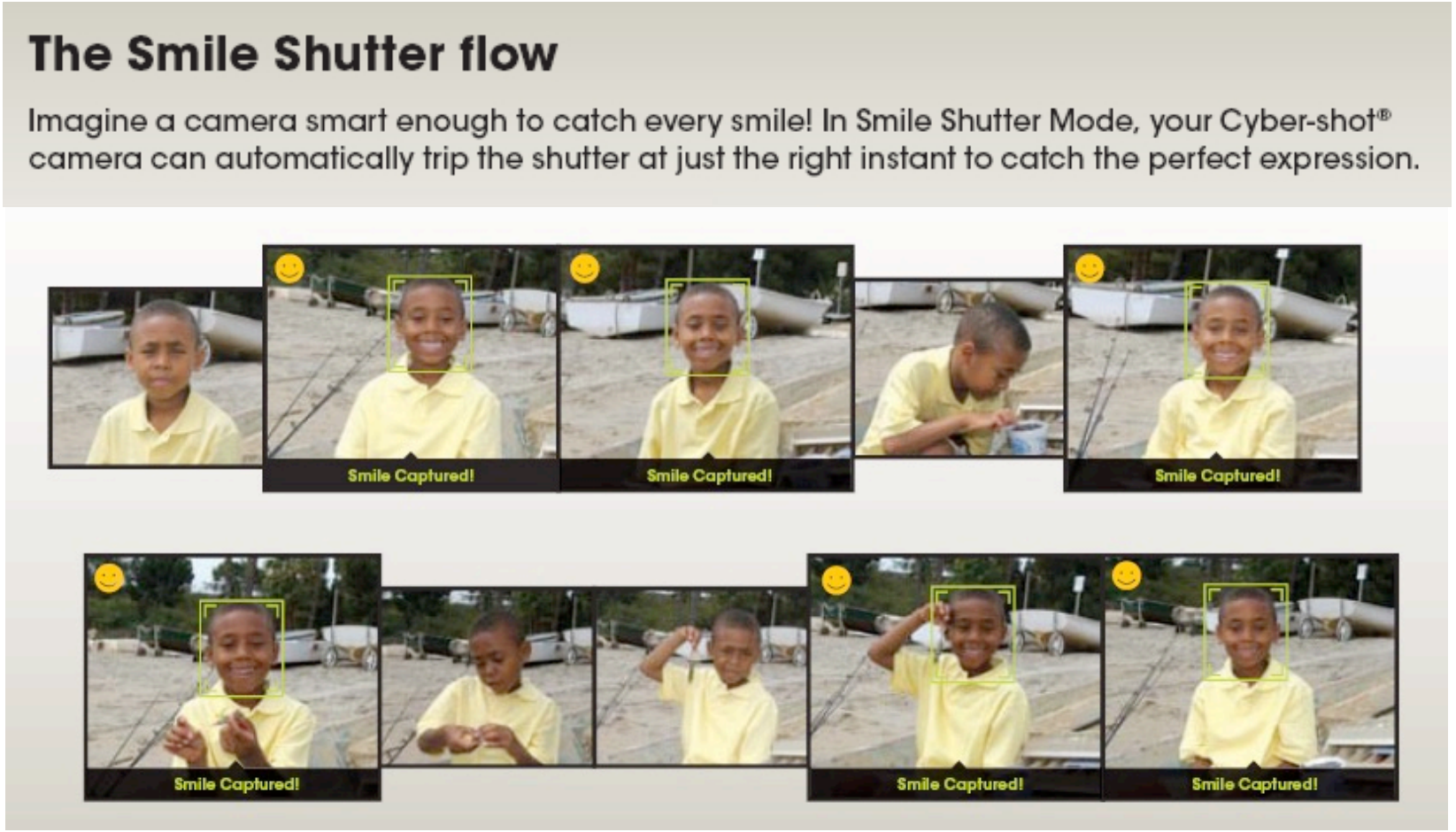
Vision-based biometrics

"*How the Afghan Girl was Identified by Her Iris Patterns*" Read the story





Smile detection?



Sony Cyber-shot® T70 Digital Still Camera

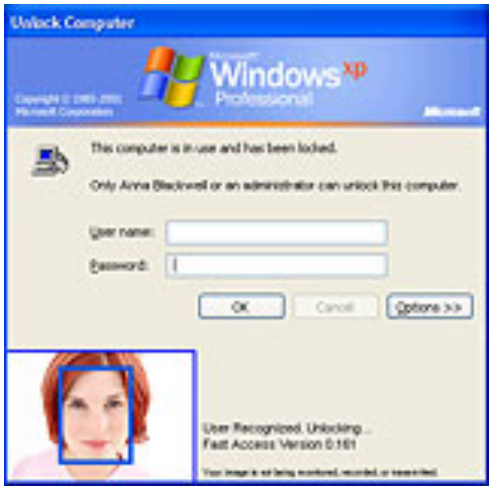
Object recognition (in supermarkets)

LaneHawk by EvolutionRobotics

“A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk,you are assured to get paid for it… “

Login without a password…

Fingerprint scanners on many new laptops, other devices



Face recognition systems now beginning to appear more widely
http://www.sensiblevision.com/

Object recognition (in mobile phones)

This is becoming real:

- Lincoln Microsoft Research
- Point & Find, Nokia

Special effects: shape capture

The Matrix movies, ESC Entertainment, XYZRGB, NRC

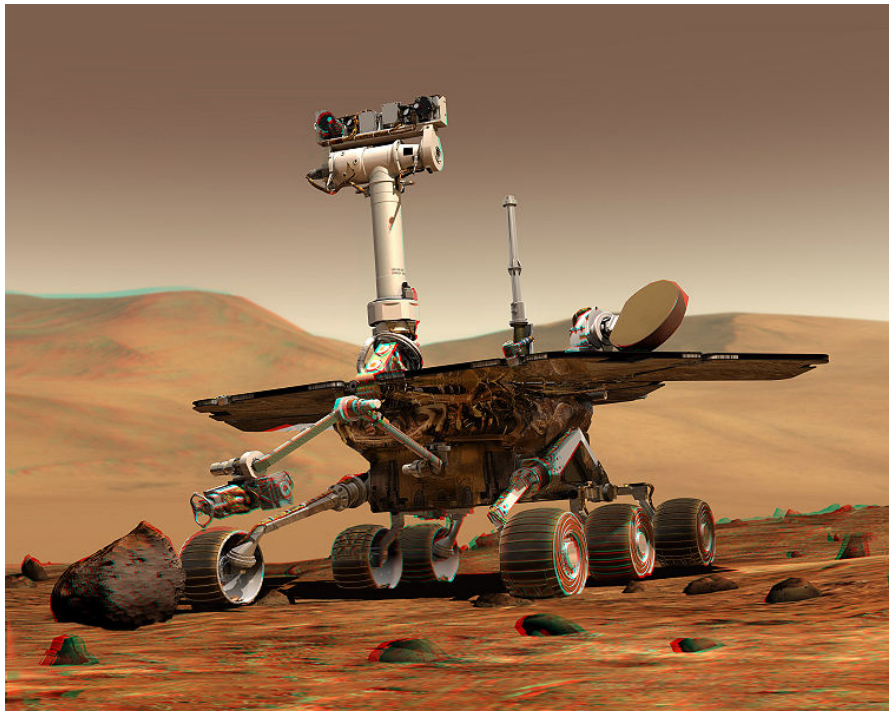
Smart cars

Slide content courtesy of Amnon Shashua

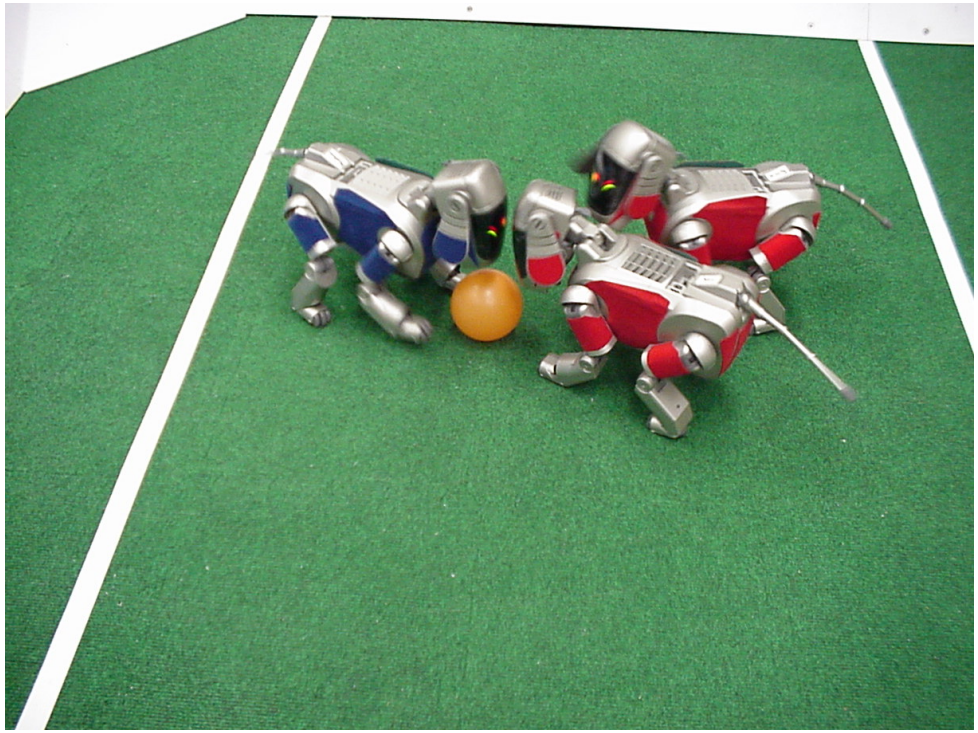
Mobileye

- Vision systems currently in high-end BMW, GM, Volvo models
- By 2010: 70% of car manufacturers.
- Video demo

Robotics

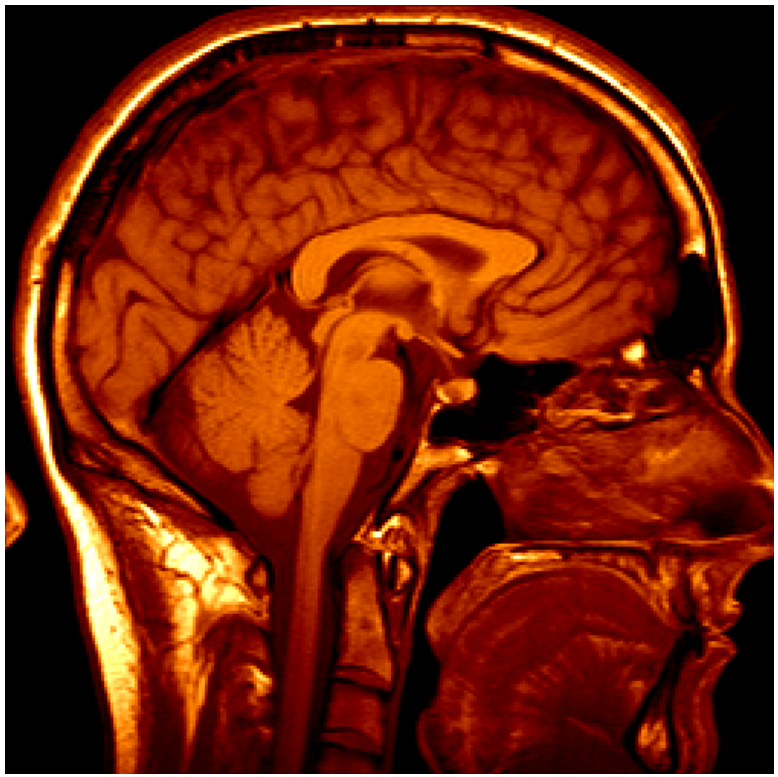


NASA's Mars Spirit Rover
http://en.wikipedia.org/wiki/Spirit_rover



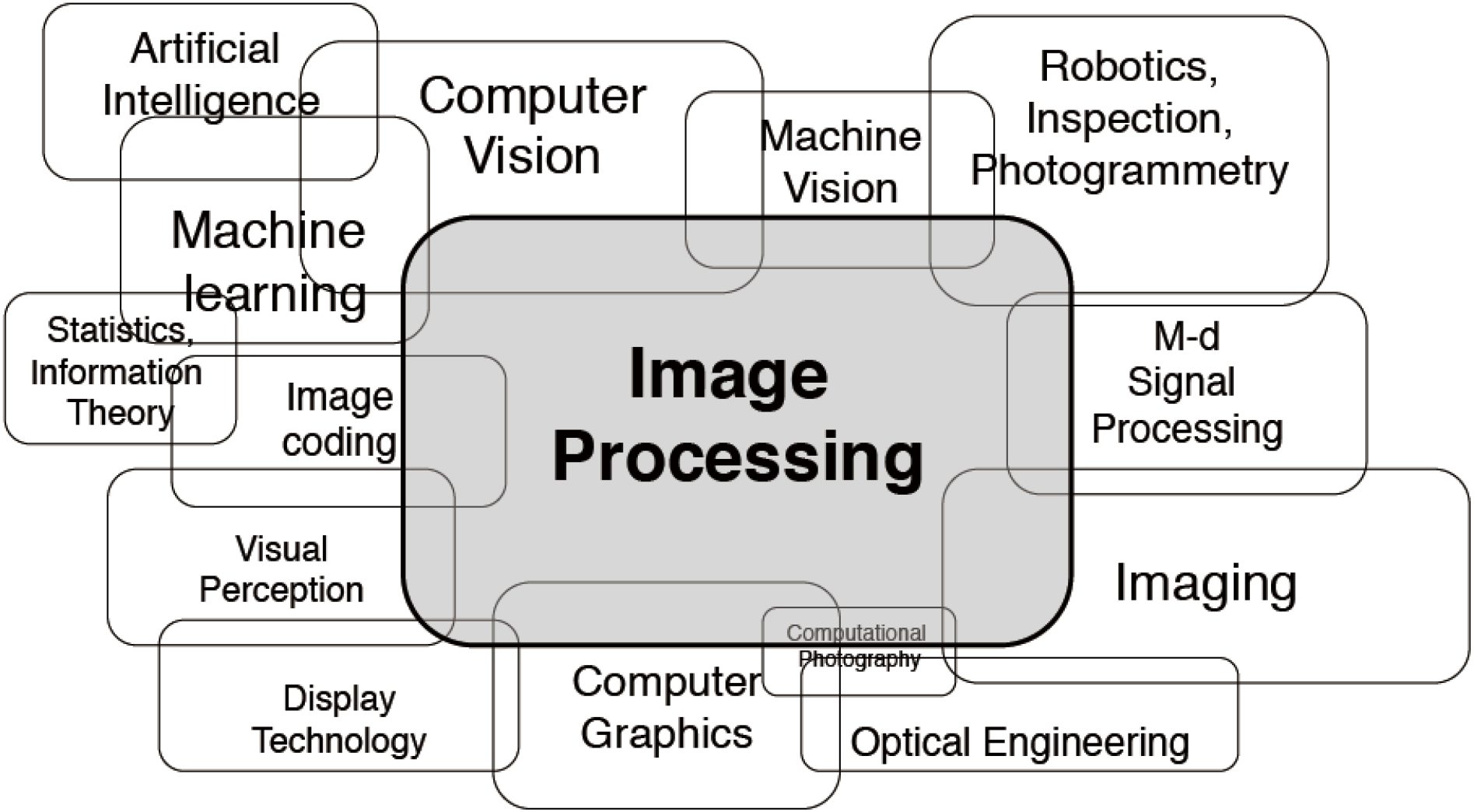
http://www.robocup.org/

Medical imaging



3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT


Artificial Intelligence
Computer Vision
Machine Vision
Robotics, Inspection, Photogrammetry
Machine learning
Statistics, Information Theory
Image coding
Image Processing
M-d Signal Processing
Visual Perception
Imaging
Computational Photography
Display Technology
Computer Graphics
Optical Engineering