Introduction to Computer Vision

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Course website:
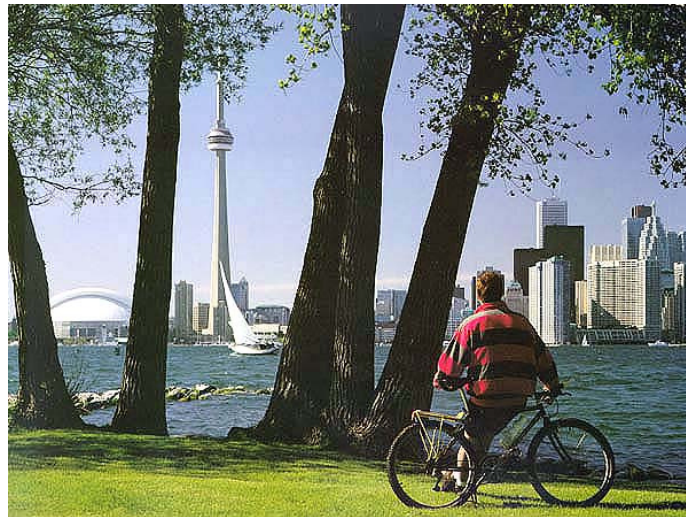   www.scs.carleton.ca/~c_shu/Courses/comp4900d/

What is Computer Vision?

The goal of computer vision is to develop algorithms that allow computer to "see".

Also called
- Image Understanding
- Image Analysis
- Machine Vision

General visual perception is hard

Digital Image

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212 209 200 188 177 173 174 171 169 165 173 176 180 187 191 192 195 195 201 203 207 210 208 212 201 177 147 143
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A brief history of computer vision

- 1960s - started as a student summer project at MIT.
- 1970s and 80s – part of AI – understanding human vision and emulating human perception.
- 1990s – depart from AI , geometric approach.
- Today – various mathematical methods (statistics, differential equations, optimization), applications (security, robotics, graphics).

What is Computer Vision?

Trucco & Verri:

Computing properties of the 3-D world from one or more digital images.

Properties: mainly physical (geometric, dynamic, etc.)

My favorite:

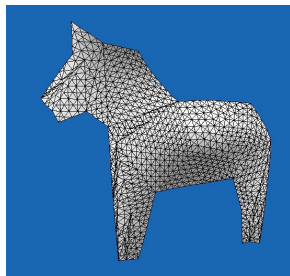Computer vision is inverse optics.

Related fields

- Image Processing
- Pattern Recognition
- Photogrammetry
- Computer graphics

Our Time

It is a good time to do computer vision now, because:

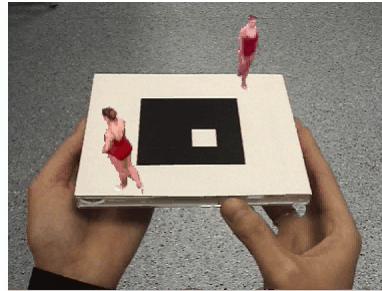- Powerful computers
- Inexpensive cameras
- Algorithm improvements
- Understanding of vision systems

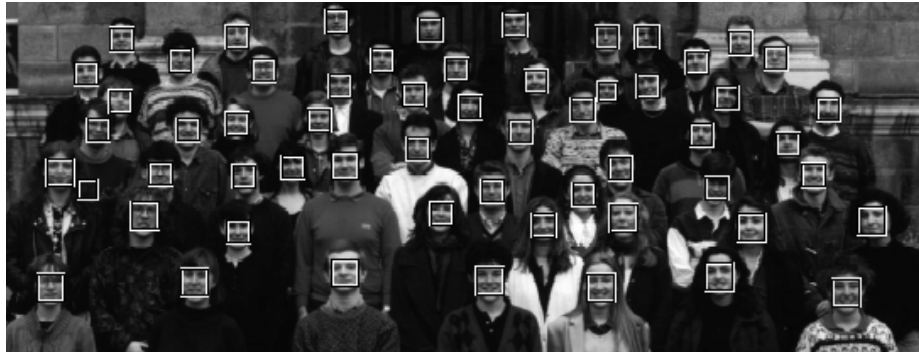## Applications: 3D Reconstruction

Augmented Reality

Fig. 2: A Virtual Object on a Card

Panoramic Mosaics

Applications: Recognition

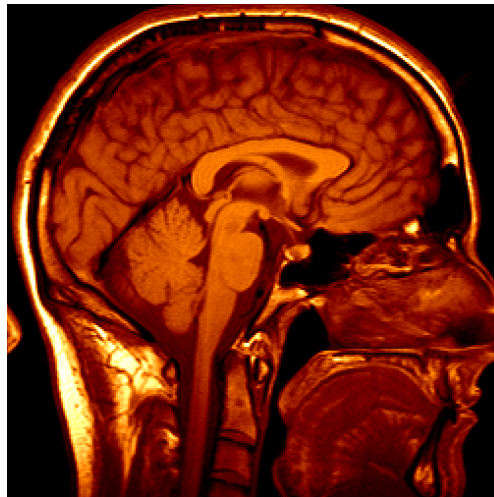## Applications: Special Effects

ESC Entertainment, XYZRGB, NRC

Applications: Special Effects

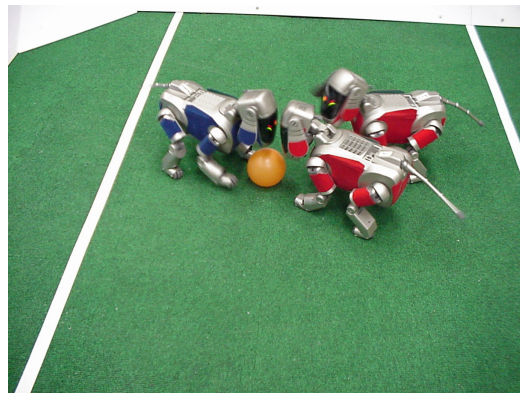Andy Serkis, Gollum, Lord of the Rings

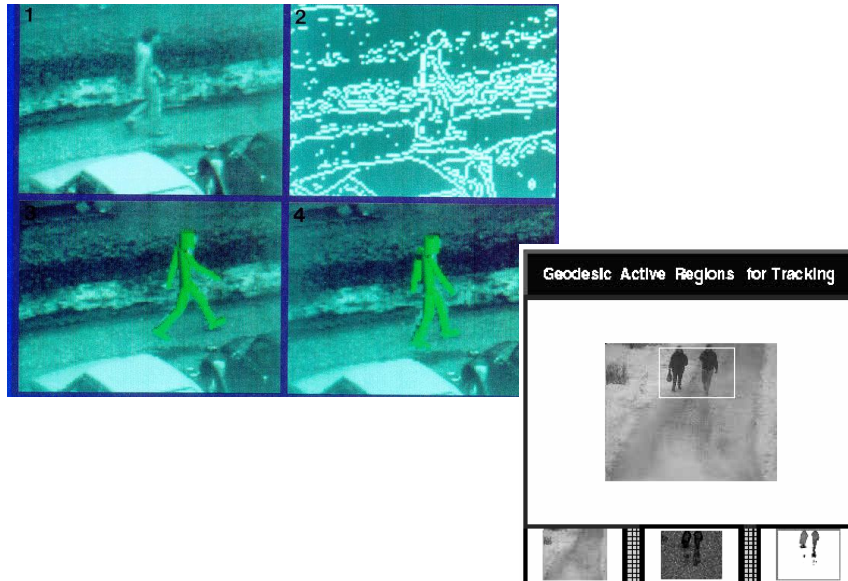## Applications: Medical Imaging

Autonomous Vehicle

Flakey, SRI

Applications: Robotics

Applications: Surveillance

Mathematical tools

- Linear algebra
- Vector calculus
- Euclidean geometry
- Projective geometry
- Differential geometry
- Differential equations
- Numerical analysis
- Probability and statistics

Programming tools

- OpenCV – an open source library for computer vision.
- Ch – a C interpretation environment.

Course Organization

Textbook: Introductory Techniques for 3-D Computer Vision, by Trucco and Verri

Two parts:
  Part I (Chang Shu) – Introduction, Review of linear algebra, Image formation, Image processing, Edge detection, Corner detection,
  Line fitting, Ellipse finding.

  Part II (Gerhard Roth) – Camera calibration, Stereo, Recognition, Augmented reality.

Evaluation

Four assignments (50%)

Two mid-terms (50%)

Programming tools

- OpenCV
    - A library of routines useful for computer vision
    - Open Source system widely used around the world
    - Contains many examples and demo programs
    - Requires VC++ or Ch interpreter to use

- VC++ or Ch
    - Assignments normally written in C++ or C
    - The easiest way to use the OpenCV library is with
        - VC++ 6.0 (examples are on the CD)
        - The .net version of VC++ should also work
        - Another option is Ch, a C interpreter (also on the CD)
        - No advantages over C++ except ease of use (but slower)

- Course CD has OpenCV and Ch interpreter