Introduction to Computer Vision

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COMP 4900C
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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
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