Computer Vision
In a Nutshell

Boris Babenko
What Is Computer Vision?

- Not Quite

Computer Vision Syndrome
Do you experience...
- Headaches?
- Blurry or double vision?
- Burning eyes?
- Eye fatigue?
- Eye irritation?
- Excessive tearing?
- Dry eye?
- Frequent blinking?

What is Computer Vision Syndrome (CVS)?

Computer Vision Syndrome (CVS) is the general term used to describe a variety of vision-related symptoms that may be aggravated by regular use of a computer for two or more hours a day.
What Is Computer Vision?

- Nope...
What Is Computer Vision?

- Goal: have a computer understand the contents image(s)
  - **Reconstruct** 3D structure from 2D image(s)
  - **Detect** and **Recognize** objects/scenes
  - **Track** and recognize behavior of object in video

- Conferences: CVPR, ICCV, ECCV
- Journals: PAMI, IJCV
Areas of Computer Vision

CVPR 2009 Papers Submitted

Object Detection and Recognition
Statistical Methods and Learning
Motion and Tracking
Segmentation and Grouping
Face and Gesture
Applications
Matching and Registration
Video Analysis for Activity Recognition
Image/Video Search and Retrieval
Medical Image Analysis
Shape Representation and Matching
Shape-from-X
Image-Based Modeling
Stereo
Color and Texture
Early and Biologically-inspired Vision
Structure from Motion
Vision for Robotics
Biometrics
Camera Calibration
Multi-view Geometry
Sensors
Vision for Graphics
Performance Evaluation
Vision for HCI
Range Image Analysis
Computer Vision

• Related Areas:
  – Machine Learning / AI / Pattern Recognition
  – Digital Signal Processing
  – Cognitive Science / Neuroscience
  – Optics & 3D Geometry
  – Computational Photography
  – Graphics
3D Reconstruction

• Robotics/navigation (e.g. Grand Darpa Challenge)
• Visualization
  – Stitching photos into panoramas
  – Google Street View
  – Microsoft Photosynth
• Entertainment: Motion Capture
• For the most part “solved”; main challenge is scaling to huge datasets
3D Reconstruction

- UCSD Alum Sameer Agarwal’s work
3D Reconstruction

• How it works:

• Popular Algorithms: SIFT, RANSAC
Towards Recognition: Low Level Vision

• Edge Detection, Segmentation, Saliency Detection
• Can only get so good without high level knowledge
• Ambiguous!
Variables affecting appearance of objects
  – Clutter
  – Occlusion
  – Illumination changes

Detection = find all instances of X in image
Localization = find location/pose of X in image
Recognition = identify X given location
Categorization = classify whole image
Recognition & Detection

RIGID

Book Covers
Frontal Faces
Fingerprints
Pedestrians
Complex Behavior

NON-RIGID

Plants
Scenes
Animals
Recognition & Detection

• Google Goggles – mobile visual search
  – http://www.youtube.com/watch?v=Hhgfz0zPmH4

• Note: asks you to fill the whole picture with the object of interest – e.g. avoid localization problem
Typical Methods

- Sliding window + classifier (face? face? face?)
- Segmentation + classifier
Current Benchmarks

• CALTECH 256
Current Benchmarks

- INRIA Pedestrians
Current Benchmarks

- PASCAL
UCSD Vision

• CSE
  – Serge Belongie: Learning + Vision, Recognition
  – David Kriegman: Photometry (lighting)
• ECE
  – Mohan Trivedi: Cars with cameras, “smart rooms”
  – Nuno Vasconcelos: Learning + Vision, Low Level Vision
• CalIT2
  – Javier Movellan: Machine Perception, Robotics, HCI
Conclusion

• Don’t take your human vision abilities for granted – very difficult for a computer
• Don’t stare at your monitor all day or you’ll get headaches and itchy eyes

• Thanks!