

Machine Vision

Lecture Set – 01

Introduction

Huei-Yung Lin

Robot Vision Lab

Instructor

- Instructor
 - Huei-Yung Lin (林惠勇)
- Class Time and Place
 - M. 10:10 – 12:00, W. 11:10 – 12:00
 - 六教325
- Office Hours
 - Tu. 8:00 am – 12:00pm, by appointment
- TA
 - 賴靖嫻, t112598008@ntut.edu.tw, Th. 13:00 – 15:00
 - 魏士涵, t112598058@ntut.edu.tw, W. 13:00 – 15:00
 - 科研大樓 1421 實驗室
- Course Materials
 - Announcements and homework assignments will be posted on web.

Textbooks

■ Required:

- “Machine Vision”, Jain, Kasturi, and Schunck, McGraw-Hill
- The textbook can be obtained from the web (licensed), (<http://www.cse.usf.edu/~rlk/MachineVisionBook/MachineVision.pdf>)

■ References:

- “Machine Vision: Theory, Algorithms, Practicalities”, E. R. Davies, Morgan Kaufmann
- “Robot Vision”, B.K.P. Horn, The MIT Press
- “Machine Vision”, W. E. Snyder and H. Qi, Cambridge University Press

Grading

- Exam – 40%
 - 20% for midterm exam
 - 20% for final exam
- Homework – 60%
 - 10% each, six homework assignments
 - All of them will be computer homework (using C/C++)
 - Due in two weeks
- All weights are approximate and subject to change

Schedule

- 3/18: Homework #1 due (assigned 3/4)
- 4/1: Homework #2 due (assigned 3/18)
- 4/22: Homework #3 due (assigned 4/1)
- 4/15: Midterm Exam
- 5/6: Homework #4 due (assigned 4/22)
- 5/20: Homework #5 due (assigned 5/6)
- 6/3: Homework #6 due (assigned 5/20)
- 6/17: Final Exam
- No classes on 3/25, 3/27

Questions?

- Grading?
- Homework, exams?
- Project?
 - (If you are interested in working on a project instead of homework assignments.)
- Who should take this course?
 - People interested in extracting information from images (termed also computer or robot vision)
 - Students taking image and vision related projects

Course Topics

- Digital Image Fundamentals
- Binary Image Processing
- Regions
- Image Filtering
- Edge Detection
- Contours
- Texture
- Optics
- Color
- Depth

What is Machine Vision?

- Vision for Machine ...
- A machine automatically processes an image and reports “what is in the image”
 - Recognize the content of the image
 - Locate and inspect the objects in the image
 - e.g., ATR (automatic target recognition), industrial inspection
- Also termed “computer vision”, “image understanding”, “robot vision”
 - Recent deep learning approaches can also be adopted for machine vision algorithms, but they will not be introduced in this course

What is Machine Vision?

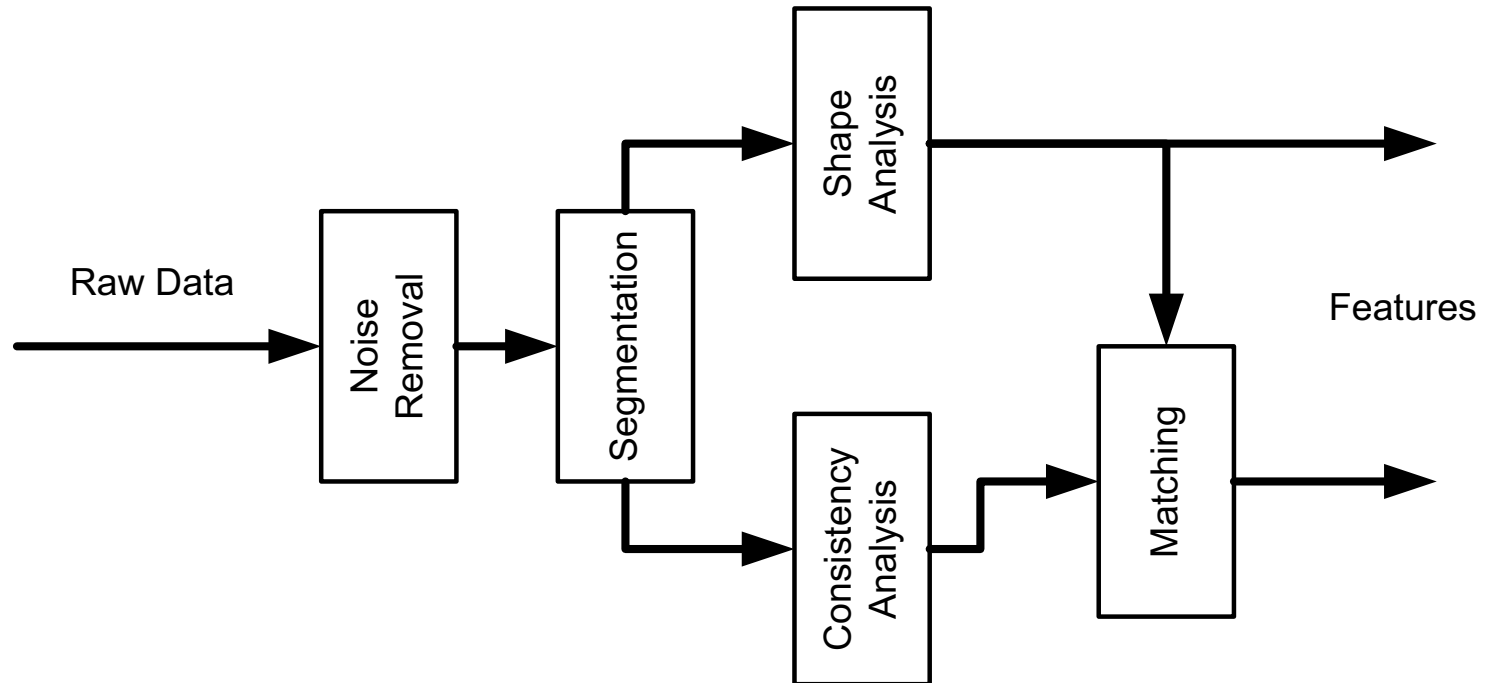
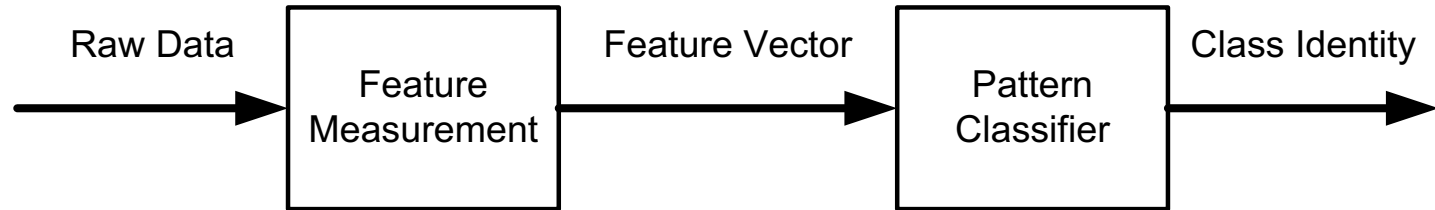
- Machine vision includes two components
 - Measurement of features
 - Pattern classification based on those features
- Measurement of features focuses on processing the image pixels and extract sets of measurements
- Pattern classification is the process of making a decision about a measurement
- For example, how to distinguish different kind of fish or machine parts?

Vision = Geometry + Measurement + Interpretation

Machine Vision vs. Image Processing

- “Image processing” tries to make images look better, the output of an image processing system is an image
- The output of a “machine vision” system is information about the content of the image
- Some image processing tasks:
 - Enhancement
 - Restoration
 - Reconstruction
 - Coding and Compression
- They are not the main concerns of vision algorithms

Machine Vision System Organization

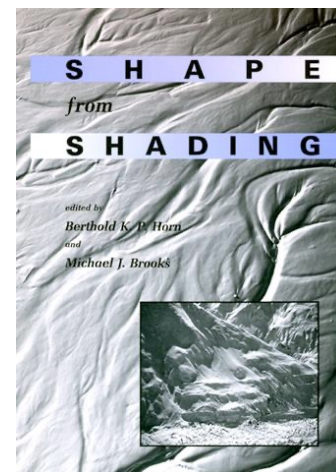


Some Examples

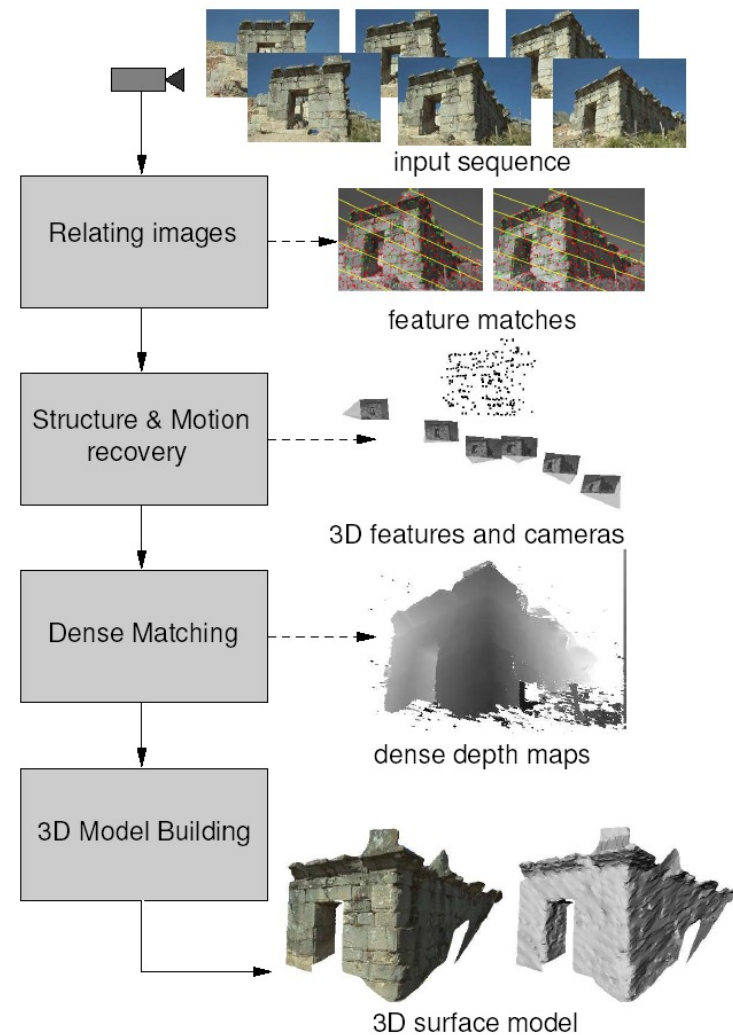
- Shape (and motion) recovery
“What is the 3D shape of what I see?”
- Segmentation
“What belongs together?”
- Tracking
“Where does something go?”
- Recognition
“What is it that I see?”

Shape from ...

- Many different approaches/cues
 - Shape from stereo
 - Shape from shading
 - Shape from texture
 - Shape from motion
 - Shape from focus/defocus
 - Shape from silhouettes
 - Shape from photometric stereo

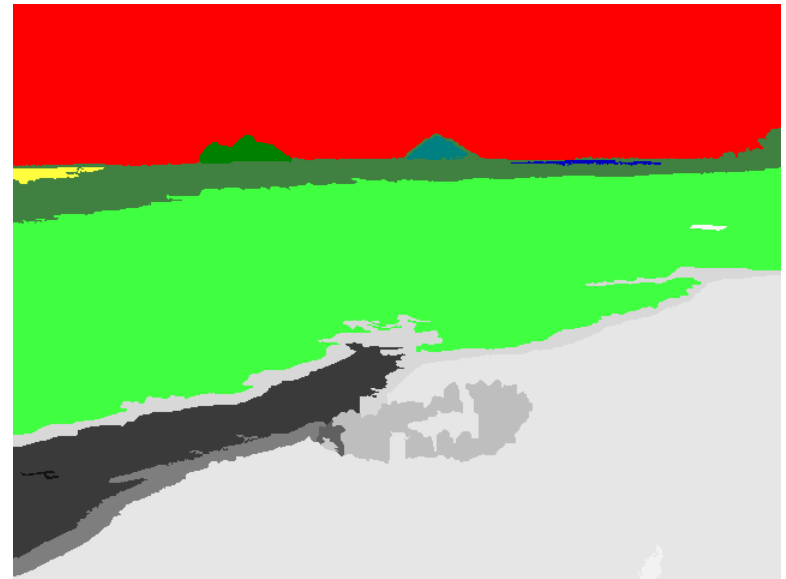


Structure from Motion



Segmentation

- Which image components “belong together”?
- Cues:
 - Similar color, similar texture
 - Form a suggestive shape when assembled



Tracking



Tracking and HCI

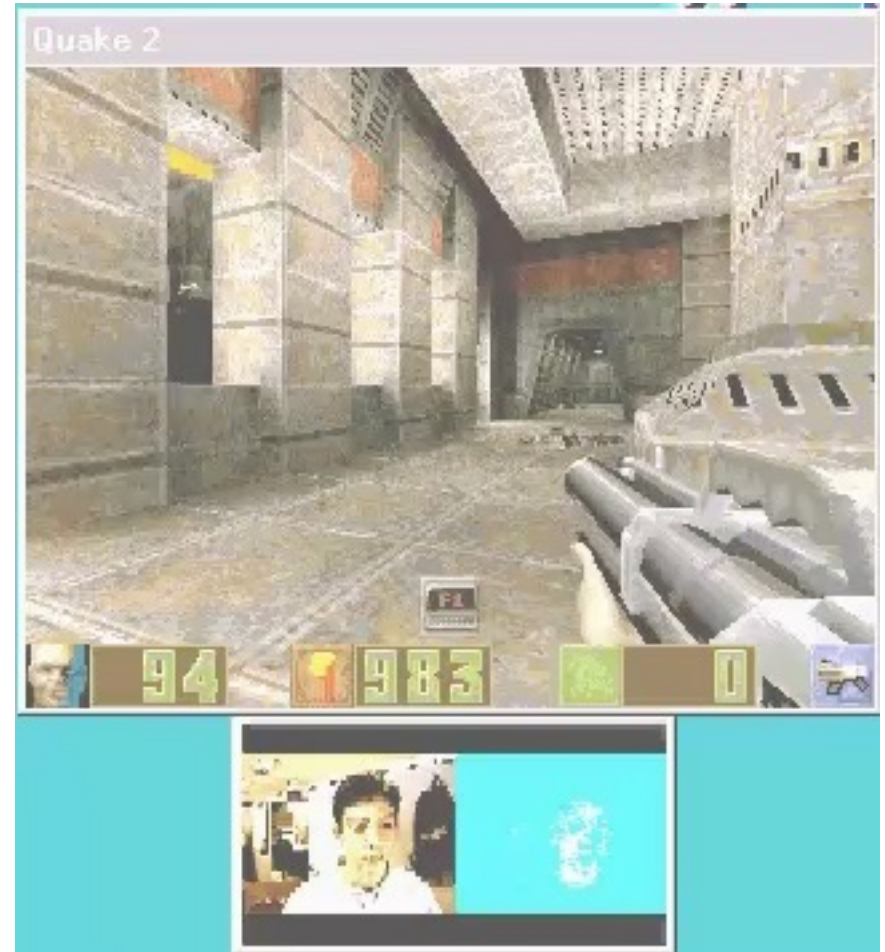
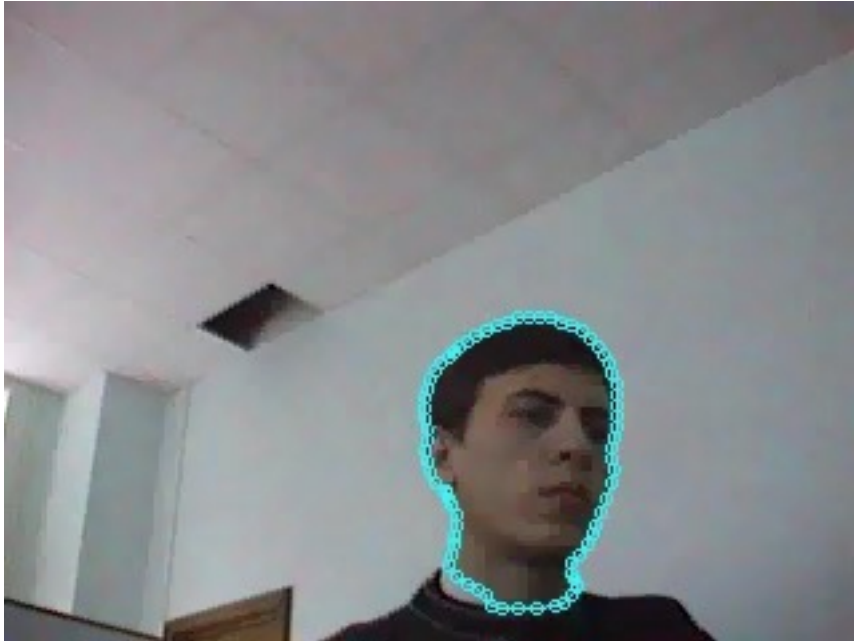
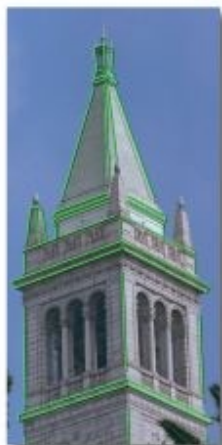


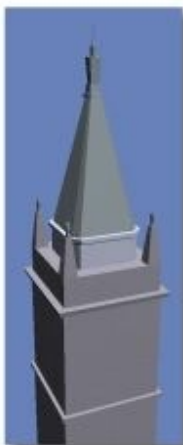
Image-Based Recognition



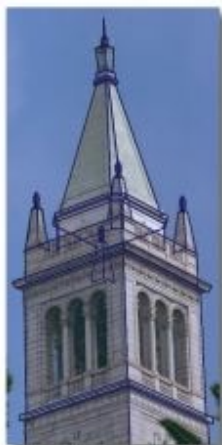
Vision for 3D Reconstruction



Original photograph with marked edges



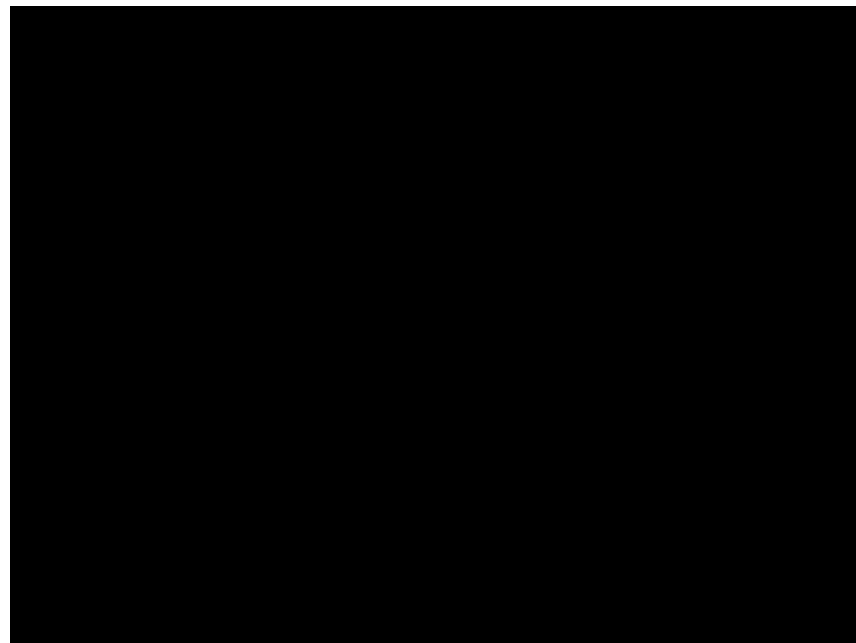
Recovered model



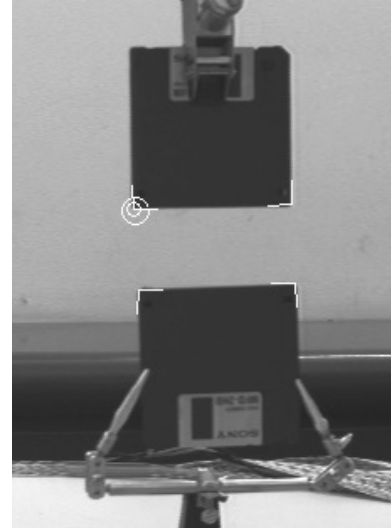
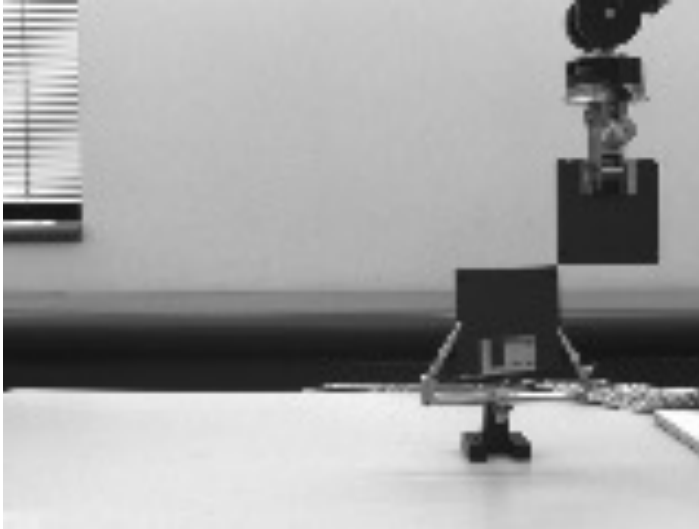
Model edges projected onto photograph



Synthetic rendering



Vision for Control



Opportunities for Vision Study

- Thanks to Moore's law – desktop machine have gotten faster and cheaper – many already come equipped with cameras
- Vision as the input device of the future – your computer will be able to:
 - Recognize you by sight
 - Watch what you do and respond accordingly
 - Build model of the world from image data

Related Fields

- Image Processing
 - Consider image properties, image-to-image transformation
 - Image processing algorithms are useful in early stages of vision tasks
- Computer Graphics
- Artificial Intelligence
- Pattern Recognition
- Photogrammetry
- Robotics

Application Areas

- Industrial inspection and quality control
- Reverse engineering
- Surveillance and security
- Face recognition
- Gesture recognition
- Autonomous vehicles
- Road monitoring
- Hand-eye robotics systems
- Medical image analysis (MRI, CT, X-rays, sonar scan)
- Image databases
- Virtual reality, tele-applications
- Space & Military
- Image based graphics