CS 682: Computer Vision

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Office Hours: Tue. 2:00-4:00pm, Thu 1:30-2:30pm or by app.
URL: http://www.cs.gmu.edu/∼zduric/
Course: http://www.cs.gmu.edu/∼zduric/cs682.html

Class Administration

How will the class work?

- I will lecture most of the time
- There will be discussions, Matlab programming examples
- There will be several homework assignments in Matlab
- There will be a midterm and a final exam
- Students will present their projects

Class Administration (cont.)

Grading

- Class participation and presentations: 10%
- Midterm: 20%
- Final: 20%
- Homeworks: 30%
- Project: 20%

Resources:

- Robotics Laboratory has several/many video cameras, R1 470
- Laboratory for the Study and Simulation of Human Movement has a other equipment, R1 470/477

Class Textbook

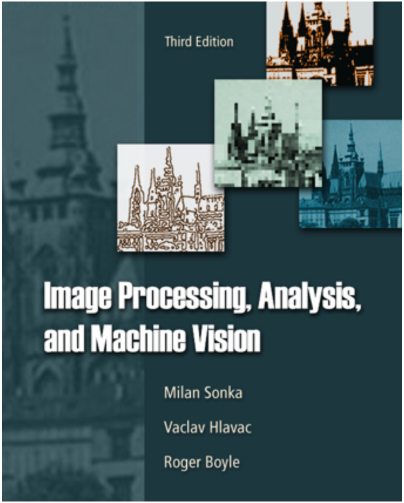
Required

M. Sonka, V. Hlavec, and R. Boyle. *Image Processing, Analysis, and Machine Vision.* Thomson 2008.

Recommended

- Matlab with Image Processing Toolbox, can be used on GMU computers for free
- Svoboda, Kybic, and Hlavec. *Image Processing, Analysis, and Machine Vision: A MATLAB Companion.* Thomson 2008.

Class notes (will be posted on the class web page).



Chapter 1: Introduction

1.1 Motivation

1.2 Why is computer vision difficult?

1.3 Image representation and image analysis tasks

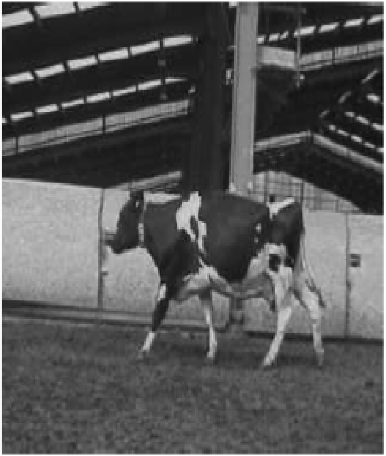


Figure 1.1: A frame from a video of a typical farmyard scene: the cow is one of a number walking naturally from right to left. *Courtesy of D. R. Magee, University of Leeds.*

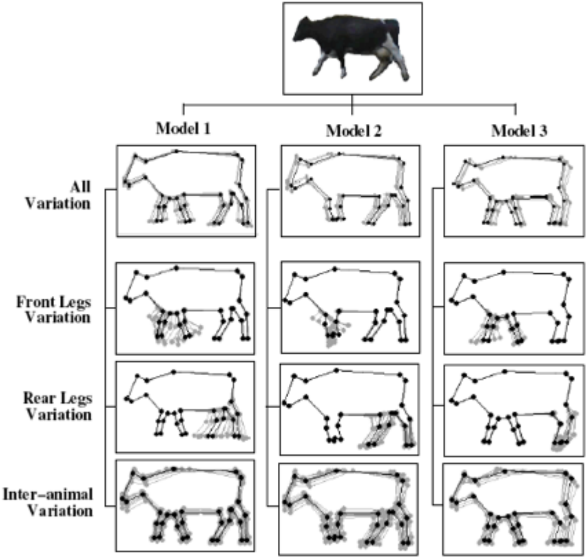


Figure 1.2: Various models for a cow silhouette: a straight-line boundary approximation has been learned from training data and is able to adapt to different animals and different forms of occlusion. *Courtesy of D. R. Magee, University of Leeds.*

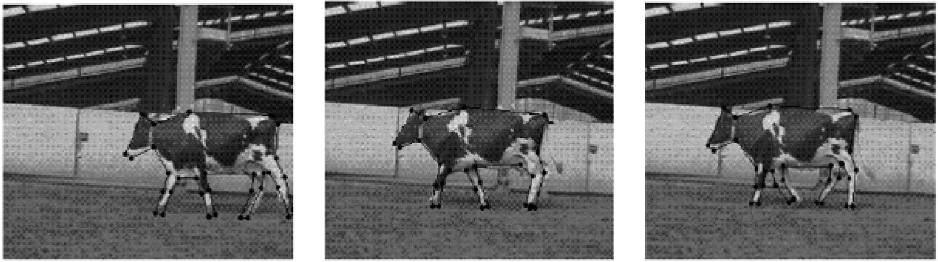


Figure 1.3: Three frames from a cow sequence: notice the model can cope with partial occlusion as the animal enters the scene, and the different poses exhibited. *Courtesy of D. R. Magee, University of Leeds.*

Why is computer vision difficult?

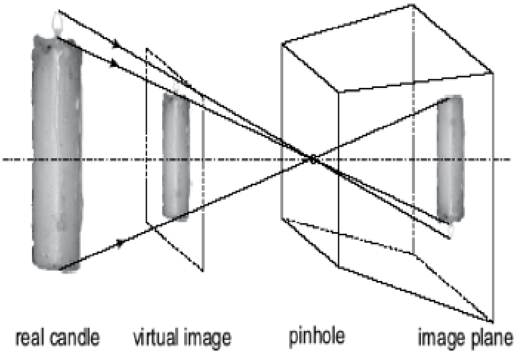


Figure 1.4: The pinhole model of imaging geometry does not distinguish size of objects.

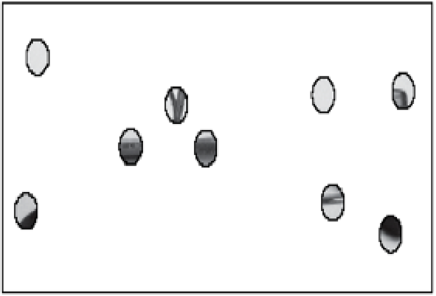


Figure 1.5: Illustration of the world seen through several keyholes providing only a very local context. Try to guess what object is depicted in the image. It is likely to be very difficult if the whole picture has not been seen yet. The complete image is shown deliberately on a different page, see Figure 1.6.

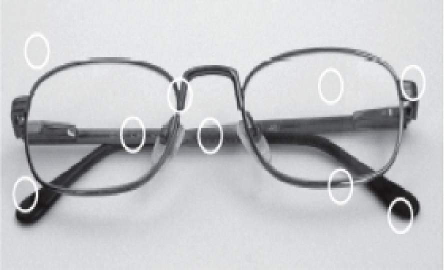


Figure 1.6: It is easy for humans to interpret an image if it is seen globally: compare to Figure 1.5.

Image representation and image analysis tasks

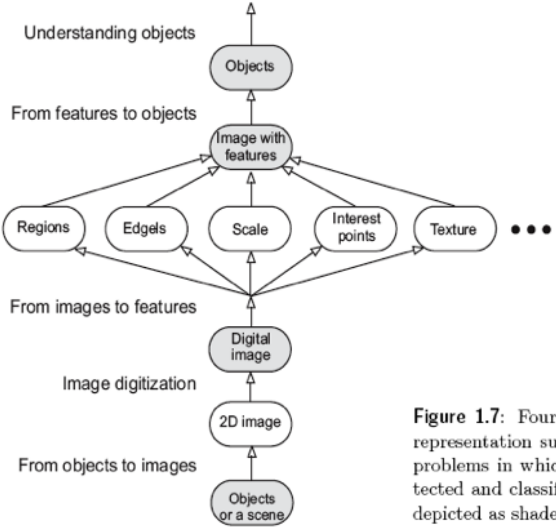


Figure 1.7: Four possible levels of image representation suitable for image analysis problems in which objects have to be detected and classified. Representations are depicted as shaded ovals.

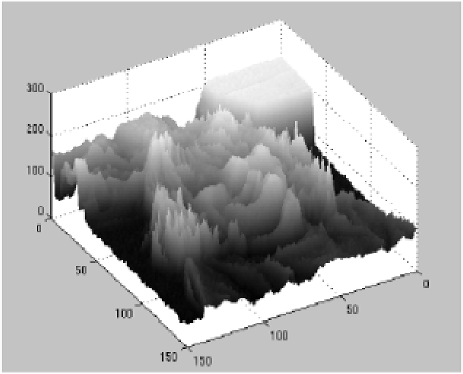


Figure 1.8: An unusual image representation.

Figure 1.9: Another representation of Figure 1.8.

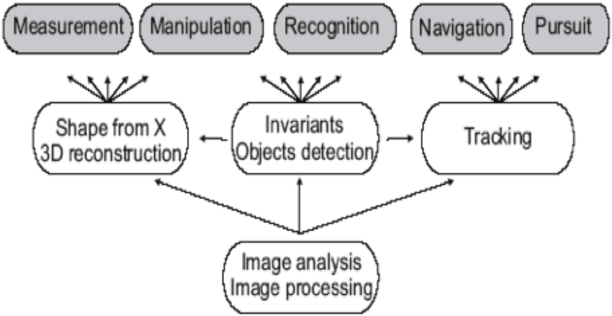


Figure 1.10: Several 3D computer vision tasks from the user's point of view are on the upper line (filled). Algorithmic components on different hierarchical levels support it in a bottom-up fashion.

Summary

- Human vision is natural and seems easy; computer mimicry of this is difficult.
- We might hope to examine pictures, or sequences of pictures, for quantitative and qualitative analysis.
- Many standard and advanced AI techniques are relevant.
- High and low levels of computer vision can be identified.
- Processing moves from digital manipulation, through pre-processing, segmentation, and recognition to understanding—but these processes may be simultaneous and co-operative.
- An understanding of the notions of heuristics, a priori knowledge, syntax, and semantics is necessary.
- The vision literature is large and growing; books may be specialized, elementary, or advanced.
- A knowledge of the research literature is necessary to stay up to date with the topic.
- Developments in electronic publishing and the Internet are making