

# Computational Vision

## Psy 5036, Fall 2006

### Study Guide

*To prepare for the final, you need to read both the lecture notes and the relevant readings.*

**Definitions of key concepts.** You will be asked to write a short paragraph on each concept discussing its definition and relationship to vision. On the exam, you will answer 8 from a selection of 12. 3 points each for a total of 24 points.

"cooperative" computation of scene properties	motion parallax
shape-from-shading	specular reflection
correspondence problem	motion field vs. optic flow
Generalized bas-relief transform	homogeneous coordinates
aperture problem	structure-from-motion
Distributed vs. modular representation	gradient space (p,q)
Inverse optics	Lightness/reflectance
lightness normalization (or anchoring) problem	lambertian
Perceptual "explaining away"	random dot stereogram
gradient descent	accidental view and generic view
slant/tilt	motion gradient constraint
subjective contours	contrast normalization
Bayes net	pictorial cues
intersection of constraints	"features of intermediate complexity"

**Long essay questions.** On the exam, you will be asked to answer 2 questions. 12 points each for a total of 24 points for this section.

1. Sketch the connections between V1, V2, V4, MT, MST. Then pick one of these visual cortical areas and describe its properties and discuss its possible function(s).
2. Explain how the motion gradient constraint could be represented in terms of spatio-temporal neural receptive fields.
3. Discuss an algorithm for the computation of lightness. What are the limitations of spatial filter-type models for lightness?
4. Can all the parameters of the eye or camera's movement in a rigid environment be recovered from the motion field? Explain. Describe one method for recovering the translational component of camera motion from optic flow to determine direction of heading.
5. Describe the Bayesian decision theory approach to visual perception. Discuss its relation to the psychology and neurophysiology of perception.

6. Discuss the computational problems of visual object recognition. Explain the difference between "structural description" and image-based (or "exemplar") theories.
7. Discuss the computational problems of visual object localization in scene layout. Describe some of the ambiguities vision must resolve in order to determine relative spatial relationships between objects.
8. Summarize and discuss the key points from one of the following papers on your reading list:
  - a) von der Heydt (2003)
  - b) Liu et al. (1995)
  - c) Hillis et al. (2002)
  - d) Weiss et al. (2002)
  - e) Tenenbaum (1999)
  - f) Poggio and Shelton (1999)
  - g) Grill-Spector (2003)