

Psy 606 (Graduate Seminar): **Perception of 3D shape**

Fall 2008

Armory 102A

Wed: 9-10am

Fri: 9-10:30am

Text: Pizlo, Z. (2008) *3D shape: its unique place in visual perception*. MIT Press.

Topics

1. Shape is special. Complexity of shape. Veridicality of shape perception (pp. 1-8).

2. “Taking into account” explanations. Shape constancy. Shape recognition. Shape discrimination (pp. 8-27).

- a. Thouless’s experiment with ellipses
- b. Stavrianos’s experiment with rectangles

3. Symmetry of 2D and 3D shapes. Invariants. Reconstruction.

Vetter, T. & Poggio, T. (1994) Symmetric 3D objects are an easy case for 2D object recognition. Spatial Vision, 8, 443-453.

Sawada, T. & Pizlo, Z. (2008) Detection of skewed symmetry. Journal of Vision 8(5), No. 14.

Sawada T. Pizlo, Z. (2008) Detecting mirror-symmetry of a volumetric shape from its single 2D image. Proceedings of the Workshop on Perceptual Organization in Computer Vision, IEEE International Conference on Computer Vision and Pattern Recognition, Anchorage, Alaska, June 23.

4. Inverse problems. Regularization theory. Bayesian inference. The role of priors. Minimum Description Length (Section 3.4, C12-C14).

Pizlo, Z. (2001) Perception viewed as an inverse problem. Vision Research 41, 3145-3161.

Poggio T., Torre V. & Koch C. (1985) Computational vision and regularization theory. Nature 317, 314-319.

Knill, D.C. & Richards, W. (1996) Perception as Bayesian inference. Cambridge University Press: NY.

5. Gestalt Psychology (Section 1.6).

- a. Figure-ground organization
- b. Simplicity principle (prior)

6. Cognitive Revolution (Sections 2.1-2.3).

- a. Information Theory
- b. Computers

c. Control Systems

Hochberg J. & McAlister E. (1953) A quantitative approach to figural "goodness". *Journal of Experimental Psychology* 46, 361-364.

Attneave F. & Frost R. (1969) The determination of perceived tridimensional orientation by minimum criteria. *Perception & Psychophysics* 6, 391-396.

Perkins D.N. (1976) How good a bet is good form. *Perception* 5, 393-406.

7. Empiricism. Transactional Psychology. Learning (Sections 2.4-2.5).

Wallach, H. & O'Connell, D.N. (1953) The kinetic depth effect. *Journal of Experimental Psychology* 45, 205-217.

Wallach, H. O'Connell, D.N. & Neisser, U. (1953) The memory effect of visual perception of three-dimensional form. *Journal of Experimental Psychology*, 45, 360-368.

Rock I. & DiVita J. (1987) A case of viewer-centered object perception. *Cognitive Psychology* 19, 280-293.

8. Geometries, groups, invariants (Sections C1-C10).

Mundy, J.L. & Zisserman, A. (1992) *Geometric invariance in computer vision*. MIT Press: Cambridge, MA (Chapters 1, 23).

9. Gibson's direct perception (Section 3.3).

10. Marr's paradigm. Surfaces (Sections 3.1-3.2).

Marr, D. (1982) *Vision*. New York: W.H. Freeman.

Koenderink, J.J., van Doorn, A.J. & Kappers, A.M.L. (1996) Pictorial surface attitude and local depth comparisons. *Perception & Psychophysics*, 58, 163-173.

Artificial Intelligence (1981) vol. 17.

11. Recovery of polyhedra (Section C11, Appendix D).

Sinha, P. (1995) *Perceiving and recognizing three-dimensional forms*. (Chapter 2) Doctoral Dissertation. MIT.

Chan, M.W., Stevenson, A.K., Li, Y. & Pizlo, Z. (2006) Binocular shape constancy from novel views: the role of a priori constraints. *Perception & Psychophysics*, 68, 1124-1139.

Sugihara, K. (1986) *Machine interpretation of line drawings*. Cambridge, MA: MIT Press.

12. Depth cues vs. priors in shape recovery (Sections 4.1-4.2).

Pizlo, Z. Li, Y. & Francis, G. (2005) A new look at binocular stereopsis. *Vision Research*, 45, 2244-2255.

13. Uniqueness of shape (Sections 4.3.1-4.3.2).

Biederman, I. (1987) *Recognition-by-components: a theory of human image understanding*. *Psychological Review*, 94, 115-147.

Biederman, I. & Gerhardstein, P.C. (1993) Recognizing depth-rotated objects: Evidence and conditions from three-dimensional viewpoint invariance. *Journal of Experimental Psychology: Human Perception & Performance* 19, 1162-82.

Dickinson, S., Pentland, A. & Rosenfeld, A. (1992b) From volumes to views: An approach to 3-D object recognition. CVGIP: Image Understanding, 55, 130-154.
Dickinson, S. & Metaxas, D. (1994) Integrating qualitative and quantitative shape recovery. International Journal of Computer Vision, 13, 311-330.

14. Viewpoint dependence (Section 4.3.3).

Poggio, T. & Edelman, S. (1990) A network that learns to recognize three-dimensional objects. Nature, 343, 263-266.

Farah, M.J., Rochlin, R. & Klein, K.L. (1994) Orientation invariance and geometric primitives in shape recognition. Cognitive Science, 18, 325-344.

Pizlo, Z. & Stevenson, A.K. (1999) Shape constancy from novel views. Perception & Psychophysics, 61, 1299-1307.

15. Shape priors (Section 4.3.4, Chapter 5).

Li, Y., Pizlo, Z. & Steinman, R.M. (2008) A computational model that recovers the 3D shape of an object from a single 2D retinal representation. Vision Research (in press).