Human Visual System 1051-720

Human Visual System describes the underlying structure of the human visual system and the psychophysical techniques used to measure its performance. The visual system's optical and neural systems responsible for collecting and detecting spatial, temporal, and spectral signals from the environment are described. The sources and extent of limitations in the subsystems are described and discussed in terms of the "enabling limitations" that allow practical imaging systems. Some laboratory/homework projects are included.

Class meeting times:

76-1275 MW 10:00 11:50
Online

Faculty:

Jeff Pelz
76-3112
5-2783
Office hours by appointment

Ethan Montag
18-1065
5-5096
Office hours by appointment

Objectives:

The primary objective of this class are for the student to gain an understanding of the overall structure and function of the human visual system, and how that structure and function inform the design of imaging systems. A related objective is an overview of fundamental experimental techniques and data analysis used in psychophysics – the scientific study of the relationship between stimuli (specified in physical terms) and the sensations and perceptions evoked by these stimuli.

Schedule:

Week	Topics	Text Chapters
1	Introduction, Overview, 1. Intro to Psychophysics	Chapter 1
2	2. Experiment of Hecht, Schlaer, and Pirenne 3. Weber and Fechner	
3	4. Threshold Techniques 5. One-Dimensional Scaling & Paired Comparison	Chapters 2 & 3
4	6. The Eye & Visual Optics 7. Photoreceptors	Chapters 4 & 5
5	8. Retinal Processing 9. Cortical Processing	Chapter 6
6	9. Cortical Processing 10. Spatial Vision	Chapters 7 & 8
7	10. Spatial Vision 11. Temporal Vision and Motion	Chapter 10
8	12. Color	Chapter 9
9	13. Depth, Stereopsis & Illusions	Chapter 11
10	Class Presentations and Review	

Textbook:

Wandell, Brian A. Foundations of Vision, Sinauer Associates, 1995

Additional Readings:

(1)Bartleson, C. J. (1984) Chapter 7, Thresholds and Matching, pp. 367-440. In: C. James Bartleson and Franc Grum (Eds.), Optical Radiation Measurements, Vol 5. New York: Academic Press.

(2)Boynton, R. M. (1980) Chapter 2, Design for an Eye, pp.38-72, In: D. McFadden (Ed.), Neural Mechanisms in Behavior. New York: Springer-Verlag.

(3)Boynton, R. M. (1984) Chapter 6, Psychophysics, pp. 335-366, In: C. James Bartleson and Franc Grum (Eds.), Optical Radiation Measurements, Vol 5. New York: Academic Press.

(4)Cornsweet, T. N. (1970) Visual Perception, Academic Press: NY, Chapters 2-4.

(5)Millodot, M. (1982) Accommodation and refraction in the eye, in The Senses, Barlow & Mollon (Eds.), Cambridge University Press

(6)Montag, E. D. (2006) Empirical formula for creating error bars for the method of paired comparison, Journal of Electronic Imaging, 15, 1, 010502-1-3.

(7)Moroney, N. M. and Fairchild, M. D. (1995) Color Space selection for JPEG image compression. Journal of Electronic Imaging, 4, 4, 373-381.

(8)Pelli, Denis G. and Farell, Bart. (1995) Psychophysical Methods (Ch. 29). In Bass, M. et al. (Eds.), Handbook of Optics, Vol 1: Fundamentals, Techniques, and Design, 2nd Ed. pp. 29.1-29.13. New York: McGraw-Hill, Inc.
(9)Smith, G. & Atchison, D.A. (1997)The Eye, in The Eye and Visual Optical Instruments, Cambridge University Press
(10)Thurstone, L. L. (1927) A law of comparative judgement. Psychological Review, 34, 273-287.
(11)Timney, Brian & Keil, (1992) Kathy. Visual acuity in the horse. Vision Research, 33, 12, 2289-2293.
(12)Woodhouse, J.M. & Barlow, H.B. (1982) Spatial and temporal resolution and analysis, in The Senses, Barlow & Mollon
(Eds.), Cambridge University Press

Evaluation:

Midterm Exam (Take Home): 25%
Final Exam (As scheduled during finals week): 25%
Term Paper/Project: 25%
Homework/labs and class participation: 25%

Homework:

All assignments are due at the beginning of class on the assigned date. Late assignments will not be accepted unless an extension has been granted before the due date.

Independent Term Paper/Project:

You are to develop and execute an independent project. This project can take the form of an in-depth research paper on some aspect of vision, perception or psychophysics or it can be a laboratory project in which an experiment is developed and carried out.

A written proposal for the independent project is due about mid-quarter (~10/2). The project topic should be discussed with the instructors well before the proposals are due. The proposal should be a one-paragraph statement of the objective and plan of your project. Final reports on these projects are due 11/6/06. The final reports should be on the order of 10-15 pages in length. Brief (~10 minute) oral presentations of the projects (incorporating the use of slide presentation software) may be given during the last week of class.

Midterm: ~ Week 5. The midterm will not be accepted late.

Final: Date TBA As scheduled.