

Format

Should be written like a scientific paper.
Might require most of the code to be put in appendices.
Can use modules you find elsewhere, but preserve copyrights, and reference
Will post final notebooks on the class web site.
Your "audience" will be your class peers.

Types of projects

Three broad types of projects are listed below.

Support of the scientific field, course development:

Develop *Mathematica* (or IPython) notebook for:
e.g. Pyramid image decomposition: Laplacian pyramid or wavelets

Develop *Mathematica* (or IPython) tutorial:
e.g. Singular value decomposition & principal components

Perceptual demonstrations

Motion illusions
e.g. stereograms, autostereograms, lightness illusions
with interactive parameter variation
<http://vipelib.york.ac.uk/>

Natural visual "mistakes"

Look for everyday visual mistakes or illusions. For example, sometimes a shadow is mistaken for a pigment change, the slant of a surface is under or over-estimated, the size of an object is incorrect, or varies depending on context, ...

Use a digital camera to document these naturally occurring illusions. Find a dozen or so, classify them, and interpret them from the point of view of vision solving a computational problem.



Visual psychophysics (quantitative measurements)

What does the eye see best?

E.g. Right-side up vs. upside-down faces. (*Mathematica* basic template notebook available)

Data analysis/report of data collected elsewhere (by you)

OK to complement other projects, but need to clarify how the work load is divided up.

Classification images

The idea is the development of a computer program that can reveal an observer's internal perceptual template for a task.

See: <http://www.journalofvision.org/2/1/introduction.html>

See: Gold et al. (2000) Ringach (1998), , Olman and Kersten (2004)

Importance of the phase spectrum in visual recognition

See, Glass patterns, Barlow and Olshausen

Models of human/biological vision

Computational models

Machine vision: but should have discussion/comparison of relevance to human vision.

Orthogonal wavelet decomposition in Mathematica

See: <http://www.cns.nyu.edu/~eero/software.html> for Matlab versions, and the Imagepyramid notebook on the class webpage.

Bayesian edge detection

Statistical analyses of images

e.g. Bayesian edge detector, correlational analyses, ...

Analyze image statistics for natural image contours

Histogram matching for textures

(e.g. Heeger, 1995)

Dynamic model of hand reach

Neural network simulations

Biologically constrained neural network for stereo vision

Neural network models

e.g. adaptive receptive field development, visual attention,...

Neuroimaging simulation

Cortical magnification

Use function interpolation to illustrate how the retinotopic map maps the visual field onto primary visual cortex.

See: <http://gandalf.psych.umn.edu/~kersten/kersten-lab/demos/RetCorLogPolInt.mov>

Linear systems analysis of cortical activity in fMRI

E.g. Boynton et al. (1996), Engel et al. (1997)

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- <http://library.wolfram.com/howtos/images/#histograms>
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