NEURL-GA 3042.005 – Spring, 2014

[cross-listed as: MATH-GA 2855, CSCI-GA 2715, PSYCH-GA 3405.005]

Representation and Analysis of Visual Images

Instructor: Eero Simoncelli

Info: Time: Tuesday/Thursday, 10-11:50
Location: Room 851, Meyer Hall, 4 Washington Place
Web: http://www.cns.nyu.edu/≈eero/imrep-course/

Brief Description: A graduate-level lecture course on theory and tools for representing, manipulating and analyzing visual images on digital computers.

Prerequisites: Linear algebra and vector calculus, linear systems theory, basic probability and statistics. Matlab programming experience is also expected.

Text: There is no textbookbook for the course. I'll provide some handouts (notes, articles, book chapters, etc) throughout the semester. For computer-vision topics, you may find the book by Rick Szeliski useful: `http://szeliski.org/Book`. For human vision topics, you may find the book by Brian Wandell useful (Foundations of Vision (https://www.stanford.edu/group/vista/cgi-bin/FOV/).

Grading: Grades will be based on homework assignments.

Topics:

1. Image formation/measurement (brief)
   - The Plenoptic function
   - light & surfaces: sources, absorption, reflectance, transparency
   - color, trichromacy (perception and technology), sensors, display devices
2. Classical tools
   - Convolution and Fourier transforms in multiple dimensions
   - PCA, spectral models, matched filtering
   - statistical inference, decision, classification
3. Analysis
   - estimation of discrete multi-dimensional derivatives
   - rotation-invariance, orientation estimation, edge detection
   - matching/alignment/registration of image content, motion estimation
   - multi-scale / coarse-to-fine methods
   - image comparison: texture classification, perceptual quality metrics
4. Representation
   - multi-scale bases (pyramids, wavelets)
   - classical and modern statistical models/representations: PCA, ICA, sparsity, random field models
   - classical and modern estimation/restoration
   - texture representation/synthesis
   - rate-distortion theory, image compression
   - invariant representations, energy models, normalization