The Exam

- Chapter 2 (excluding 2.5)
- Chapter 3
- Chapter 4 (excluding 4.4)
- Chapter 5.1, 5.2
- Chapter 6
- Chapter 7 (excluding 7.4.3)
- Chapter 8 (excluding 8.5.2)
- Corke article
- extra material on reflection from F&P
- basic Matlab
- extra material on color
Week 2

• Image noise
  – additive noise model
  – shot noise

• Convolution
  – basic algorithm
  – averaging, Gaussian templates
  – derivatives

• Fourier representation
  – Convolution theorem

• Image gradients
  – smoothing plus derivatives
Week 3

• Edge detection
  – edge types
  – gradient direction
  – magnitude

• Canny edge detector
  – assumptions
  – localization vs. detection tradeoff
  – nonmaximal suppression
  – hysteresis thresholding

• Hough transform
  – edges
  – extensions to other parametric forms
Week 4

• Grouping algorithms
  – neighborhood definitions
  – simple morphology
  – connected component labelling
  – top down partitioning
  – bottom-up grouping

• Reflectance
  – radience
  – irradiance

• BRDF functions
  – Lambertian surfaces
  – specular surfaces
Week 5

- Camera models
  - pinhole
  - thin lens
  - perspective
  - orthographic

- Algebraic forms for camera models
  - projective model

- Camera calibration
  - direct methods
  - indirect methods
  - overall algorithm
  - intrinsic vs. extrinsic parameters
Week 6

• More calibration
  – general idea of getting to a linear form
  – properties of SVD
  – direct calibration algorithm
  – idea of indirect algorithm

• Rectification
  – essential idea
  – algorithm

• Stereo
  – non-verged equations --- disparity
  – epipolar geometry
  – use of rectification to convert systems to non-verged
Week 7

• Stereo cont’d
  – E matrix
    • derivation and structure
  – F matrix
    • derivation from E matrix and intrinsics
  – reconstruction up to scale

• Correspondence
  – matching metrics
  – use of epipolar geometry (and rectification)

• Overall stereo algorithm
• Corke article for stereo evaluation
Week 8

• Motion problem
  – motion field
  – translation vs. rotation structure
  – FOE and TtC

• Motion of planar objects
  – orthographic = affine
  – perspective = quadratic
  – idea of parallax

• The optical flow field
  – image constancy constraint
  – aperture problem
  – two general methods for computing flow
    • regularization
    • finite patch
Week 9

• Computing optical flow
  – derivation of the least squares estimate of displacement
  – the iterative version of the algorithm
  – from flow to tracking
    • incremental
    • reference

• The factorization method
  – assumptions
  – problem formulation
  – rank theorem
  – final algorithm
Projects

• Ground rules
  – ideally two people/project
  – due at the end of reading period
  – submit a writeup showing results of experiments and code.
  – sanity check one week before the end of the semester
    • show results on simulation and/or simulated data
    • identify data that will be used for real experiments

• Possible projects
  – stereo
  – motion
  – grouping
  – tracking
  – other topics by approval

Due on Thursday: groups and projects

• Grading
  – simulation, testing at checkpoint (30%)
  – completeness and thoroughness (40%)
  – evidence of understanding topic (20%)
  – style (10%)