Computer Vision, Lectures 19, exam

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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
  - irradience
- 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 = quadractic
  - 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%)