Review and Summary

We have covered a LOT of material, spending more time and more detail on 2D image segmentation and analysis, but hopefully giving you a feel for 3D, too.

1. Binary Images and Classification (Chs. 3-4)
2. Color, Texture, and Segmentation (Chs. 6, 7, 10)
3. Content-based Image Retrieval (Ch 8)
4. Motion (Ch 9)
5. 3D Perception and Sensing (Chs. 12 and parts of 13)
6. Object Recognition (Chs. 11 and 14)

Binary Images and Classification

- Finding good thresholds
- Connected components operator
- Mathematical morphology
- Region properties
- Region adjacency graphs
- Feature extraction
- Feature vectors
- Classifiers

Color and Texture

- Color spaces: RGB, HIS
- Color histograms
- Color image segmentation via clustering
- Mathematical models of shading

- Structural vs statistical approaches to texture
- Common statistical measures
  - Edge density and direction histograms
  - Local binary pattern histogram
  - Co-occurrence matrix features
  - Laws texture energy measures
  - Autocorrelation
- Texture-based segmentation

Segmentation

REGIONS
- region growing using a statistical approach
- clustering
  - K-means and isodata
  - Recursive histogram-based clustering
  - Shi's graph cut partitioning

LINES AND ARCS
- Tracking
- Hough transform
  - line segments
  - circular arcs
- Burns line finder

Content-Based Image Retrieval

- Query by example
- Image distance measures
  - color
    - ° color histograms
    - ° gridded color
  - texture
    - ° texture summary features
    - ° texture histograms
    - ° gridded texture
  - shape
    - ° tangent angle histograms
    - ° boundary matching
  - regions and spatial relationships
- Object recognition
  - ° face detection
  - ° flesh detection

Motion

- Change detection
- Optic Flow
  - interest points
  - regions
  - Ming's algorithm: local analysis plus global optimization
- Tracking
- Application to MPEG video compression
- Video segmentation and structuring (Daniel G. P.)

3D Perception and Sensing

- Intrinsic image approach
- Perspective imaging model
- Depth from stereo with parallel camera axes
- Finding correspondences
  - correlation
  - symbolic matching
  - epipolar constraint
  - ordering constraint
- Camera model
- Tsai's camera calibration algorithm
- General stereo
- Pose estimation (not covered, but used in AR)
- 3D object reconstruction from range data

Object Recognition

- Affine transformations
- Alignment
  - local-feature-focus
  - pose clustering
  - geometric hashing
  - surface signatures
- Relational matching / relational distance
  - via tree search
  - via discrete relaxation
  - via probabilistic relaxation
- Relational indexing
- Deformable models
- Functional models
- Appearance-based recognition