Computer and Machine Vision

Lecture Week 13
Part-1
Dense Motion Analysis
Outline of Week 13

Dense Motion Analysis
- Review of Scalar / Tensor View of Images
- Pixel Motion Vectors
- Motion Vectors
- Optical Flow

Exam #2 Review
Revisiting Image Formats

Single Frame Image
- Composed of Pixels, Which Can be Treated as 3-space Vector with Red, Green, Blue Intensity (Color Cube)
- RGB vectors are mapped to X,Y Frame
- Math Calls this a Tensor Field

Feature Vectors are Based on X,Y Intensity Gradients (in one color channel typically) – Different type of vector, but also a vector field

Motion Vectors are Based on Frame to Frame Movement of Macroblocks, Features or Pixels
Examples – RGB, YUV Image

- Color Bars (Shows Basic Variation of RGB Vectors Spatially – to test Color Emission)
- NTSC Signal Contains Y+Sync, and Modulated U and V (Cb, Cr)

http://en.wikipedia.org/wiki/Color_bars
http://en.wikipedia.org/wiki/Vectorscope
http://en.wikipedia.org/wiki/YUV
SIFT Feature Vectors

- Gradient Vectors Noted on Image
- Forms Signature for Image
- SiftDemoV4
Motion Vectors & Optical Flow

Motion of Pixels, Macroblocks (ROIs) or Features Frame to Frame – See CV Ch. 8

http://www-inst.eecs.berkeley.edu/~ee225b/sp10/lectures/12-MotionEstimation.pdf
Motion Blur vs. Motion Vectors

- High Motion Scene Causes Blur in Single Frame
- Due to Detector Integration Time Relative to Object Motion Rates
- Motions with High Speed Integration Time still Causes Blocks, Features, Pixels to Translate Frame to Frame (Search and Match with Error Minimization)

http://en.wikipedia.org/wiki/Motion_blur
Motion Compensation

- Important for Difference Images and Background Elimination
- Known Platform Motion Simplifies (dolly, track, boom – fwd/back, left/right, up/down translation, tilt/pan/rotation)

http://en.wikipedia.org/wiki/Motion_compensation
Optical Flow Concepts

Where are Objects Moving Frame to Frame due to Scene to Observer Relative Motion?

Useful for Flying or Moving Object Platforms (Robotics)

Optical Flow - OpenCV

David Stavens – Stanford AI Lab

Slides Posted on Blackboard too

http://robots.stanford.edu/cs223b05/notes/CS%20223-B%20T1%20stavens_opencv_optical_flow.pdf
Gesture Recognition

- Segmentation of Foreground Moving Objects (Head, Shoulders, Arm, Hand, Fingers)

- Background Elimination (Motion Compensation – for Camera/Observer)

- Track Edges or Features, Bound with Boxes or Ellipses, Search for Matches

- Automated Sign Language (ASL) is Unsolved Problem
Summary

Images are Tensor Fields
  – Due to Color
  – Due to Motion
  – Due to Intensity Gradients (Features and Edges)

Structure Derived From Motion

Structure Derived From Lighting

Structure Derived From Stereopsis

Sensor Fusion?