CAP 6411 Computer Vision Systems

- Instructor: Dr. Mubarak Shah, shah@cs.ucf.edu, 238 CSB, http://www.cs.ucf.edu/courses/cap6411
- Office Hours:
  - 2PM to 3PM Mon, 4PM-5PM Tu, 5:15PM-6:15 PM Wed
- Grading
  - Mid term 20%, Final 25%, Programs 45% , Homework 10%
- Recommended Book, but not required.
  - Digital Video Processing, A. M. Tekalp, Prentice Hall.

Multimedia

- Text
- Graphics
- Audio
- Images
- Video

Imaging Configurations

- Stationary camera stationary objects
- Stationary camera moving objects
- Moving camera stationary objects
- Moving camera moving objects

Video

- sequence of images
- clip
- mosaic
- key frames

Sequence of Images

Clip

Mosaic

Key Frames

Steps in Video Computing

- Acquire (CCD arrays/synthesize (graphics))
- Process (image processing)
- Analyze (computer vision)
- Transmit (compression/networking)
- Store (compression/databases)
- Retrieve (computer vision/databases)
- Browse (computer vision/databases)
- Visualize (graphics)

Computer Vision: Motion

- Motion Detection
- Motion Measurement (optical flow)
- Tracking
- Structure from motion (derive 3-D motion & shape)
- Motion Recognition
- Motion-based Recognition

A Video Clip

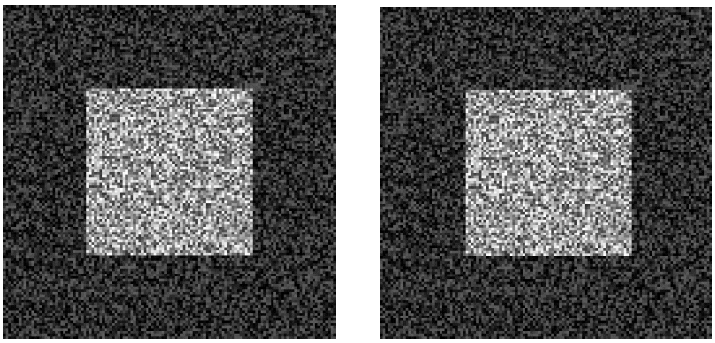
Consecutive Frame Difference

Background Difference

Optical Flow

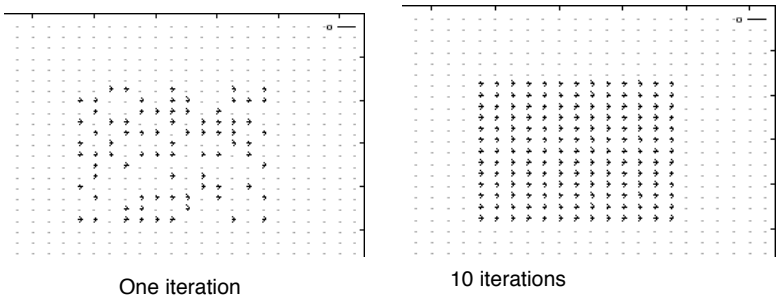
Measurement of motion at each pixel

Synthetic Images



(Random dot stereogram)

Results



One iteration

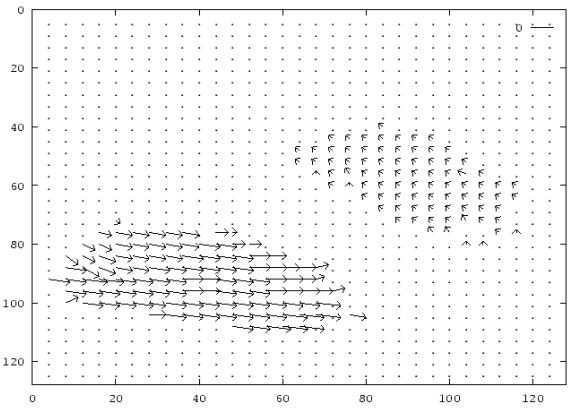
10 iterations

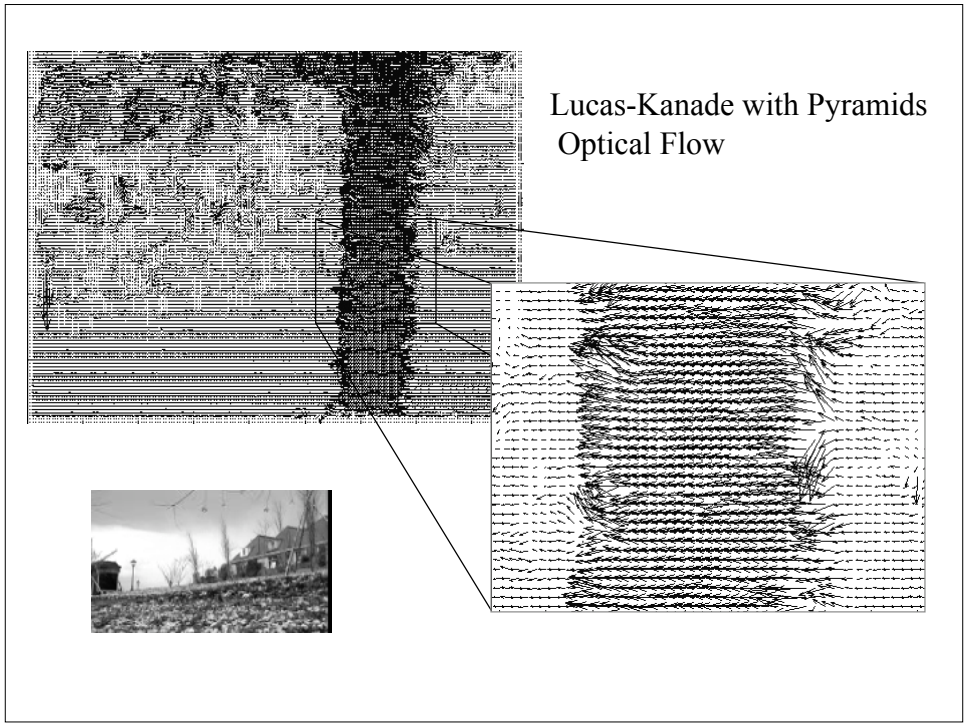
$\lambda = 4$

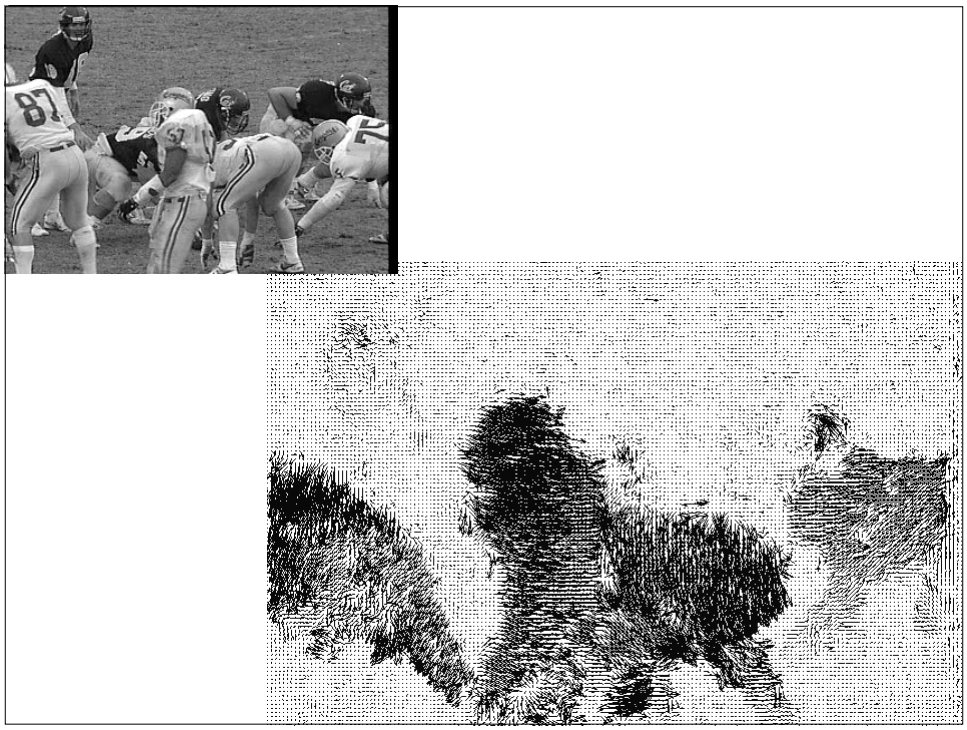
Horn-Schunck

Image from Hamburg Taxi seq

optical flow

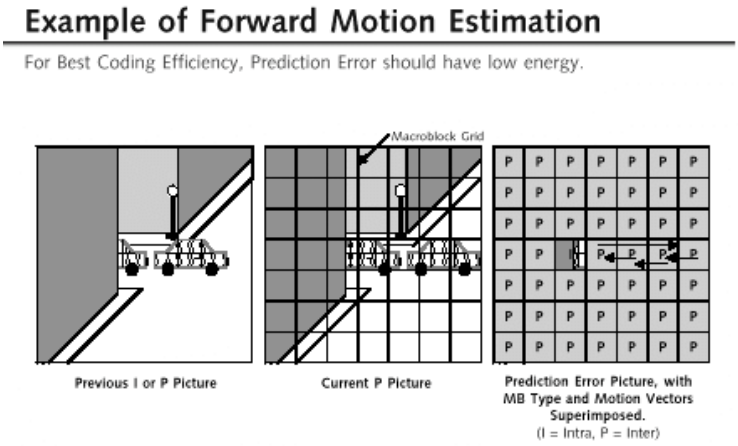



Lucas-Kanade with Pyramids
Optical Flow

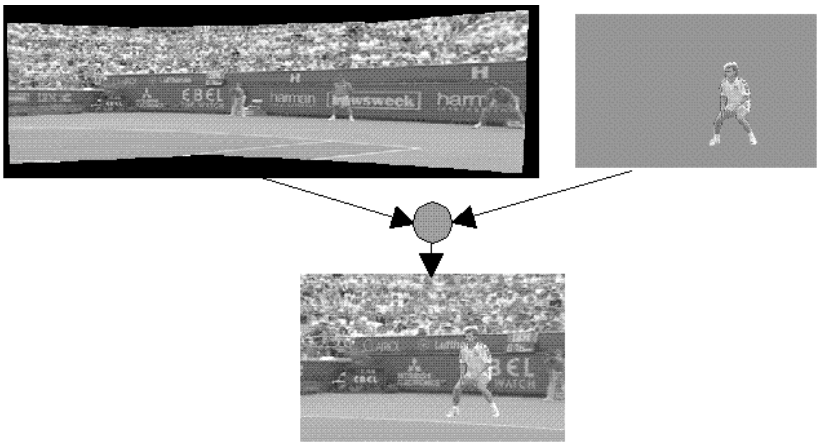


Video Compression

Example



Sprite



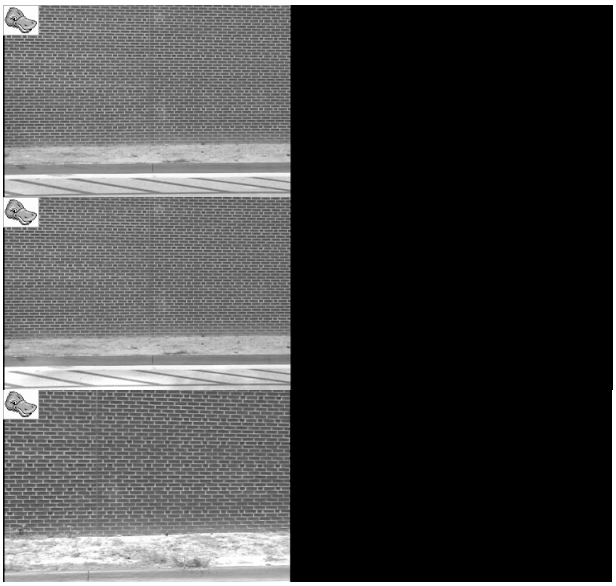
Tracking

Tracking & Object Detection In Single Camera

Motion Recognition

Activities

Detecting Violence

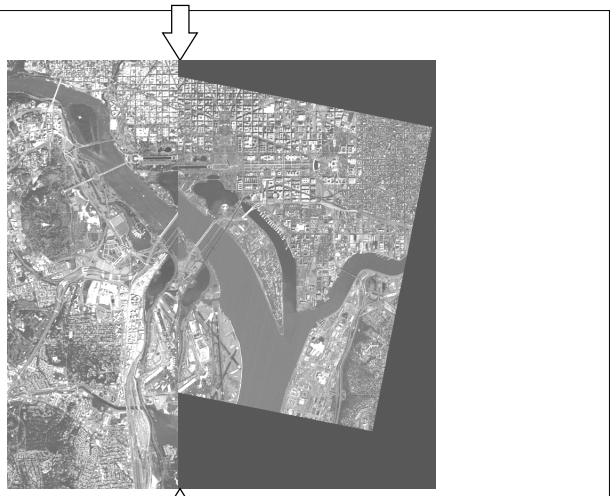


Video Registration

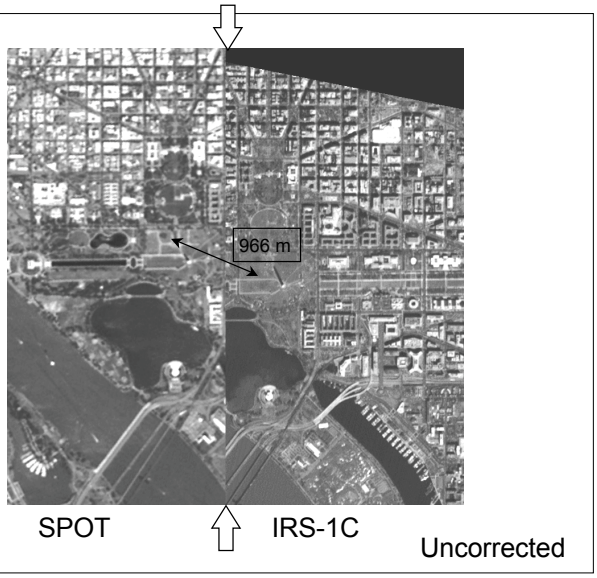
IRS-1C - Washington, DC

SPOT - Washington, DC

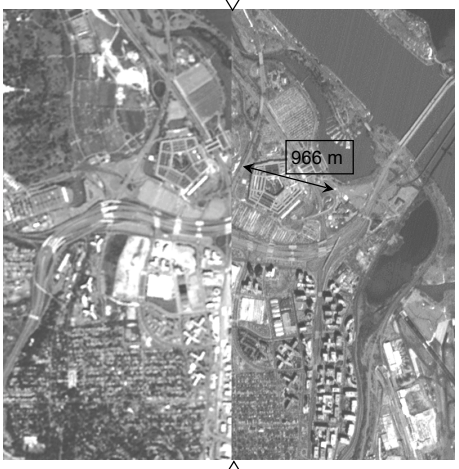
SPOT/IRS-1C Uncorrected



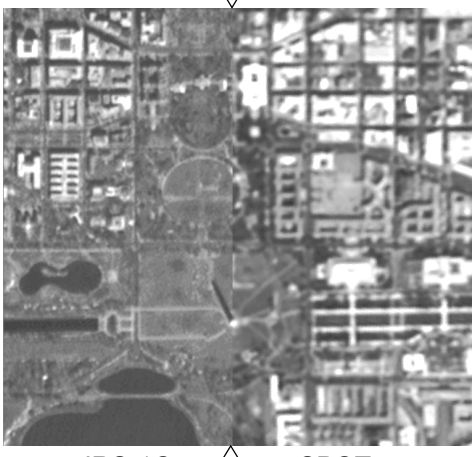
SPOT/IRS-1C Uncorrected



SPOT/IRS-1C Uncorrected



IRS-1C/SPOT Registered



Registered IRS-1C to SPOT

Video Segmentation

Image Processing

- Filtering
- Compression
  - MPEG-1
  - MPEG-2
  - MPEG-4
  - MPEG-7 (Multimedia Content Description Interface)

Databases

- Storage
- Retrieval
- Video on demand
- Browsing
  - skim
  - abstract
  - key frames
  - mosaics

Networking

- Transmission
- ATM

Computer Graphics

- Visualization
- Image-based Rendering and Modeling
- Augmented Reality

Contents

Contents

Detailed Contents

Detailed Contents

1. Generating Trajectories
    1. Token Detection
        1. Moaravec's Interest Operator
        2. Lucaas Kanade Operator
    2. Motion Correspondence
    3. Kalman filter for motion correspondence

Detailed Contents

1. Video mosaics
    1. Introduction
    2. Projection surfaces
        1. Plane
        2. Sphere
        3. Cylinder
    3. Static Mosaic
    4. Synopsis Mosaic
2. Visual gesture recognition
    1. Jim
    2. Andrew
    3. Pentland
3. Visual lipreading
    1. Shawn

Detailed Contents

1. Facial expression recognition
    1. Yacoob and Black
2. Human activity recognition
    1. Polana and Nelson
    2. Jim
    3. Model-based Activity Recognition
3. Video compression
    1. Brief Introduction to JPEG
    2. Brief Introduction to MPEG-1
    3. Brief Introduction to MPEG-2
    4. Model-based Compression
        1. Video phones
        2. Szeliski
        3. Making faces
    5. MPEG-4
    6. MPEG-7

Detailed Contents

1. Tools
    1. Pyramids
    2. Interpolation
    3. Color Science
    4. Image Warping
    5. Kalman filter
    6. Hidden Markov Models
    7. Finite State Machine
    8. Dynamic Time Warping