

# **CAP 5415 Computer Vision Fall 2013**

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[www.cs.ucf.edu/~vision/courses/cap5415/fall2011](http://www.cs.ucf.edu/~vision/courses/cap5415/fall2011)

Office 245-D HEC



# Contents

1. Introduction
2. Filtering, Differentiation (**Program-1**)
  - Noise removal, Sobel, Prewit, Robert, Laplacian
3. Edge Detection
  - Marr-Hildreth, Canny (non-maxima suppression, Hysteresis thresholding)
4. Harris Corner Detector
  - Auto correlation, Cornerness, eigen values of covariance matrix
5. SIFT (**Program-2**)
  - Difference of Gaussian, extrema in scale space, localization, removing outliers, finding the orientation
  - Descriptor

# Contents

6. 5.5 HOG
  - HOG
  - Optical flow constrain equation, normal flow, Horn Schunck, Lucas-Kanade
7. Pyramids
  - Gaussian, Laplacian, Compression using Pyramids, optical flow using pyramids
8. Motion Models
  - Translation, rotation, rigid, affine, homography, pseudo perspective, bi-linear, bi-quadratic

# Contents

9. Global Motion Estimation
  - Bergen et al (affine)
  - Mann and Picard (projective)
10. KLT (**Program-3**)
11. Mean-Shift Tracking
12. Camera Modeling and Calibration
13. Fundamental matrix
  - Derivation, 8 point algorithm
  - Robust Estimation

# Contents

## 14. Face Recognition

- Eigen Faces, LDA

## 15. Structure from Motion

- Tomassi-Kanade
- Rank Constraint, Singular Valued Decomposition

## 16. Bag of words

- K-means, SVM, Evaluation metrics

## 17. Hough Transform

- Line, Circle
- Generalized Hough Transform

# Contents

## 18. Detection & Tracking

- Background Difference
- Tracking multiple objects
- Connected components

# Course Material

- Lecture Slides
- Program-1 and Program-2, Program-3
- Homework-1, and Homework-2

# Reading Material

- Filtering
  - Chapter 2: Fundamental of Computer Vision
- Edge Detection
  - Chapter 2: Fundamental of Computer Vision
- Harris Corner Detector
  - Chapter 3: R. Szeliski: Computer Vision: Algorithms and Applications



# Reading Material

- SIFT
  - Chapter 3: R. Szeliski: Computer Vision: Algorithms and Applications
    - **Distinctive image features from scale-invariant keypoints, D. Lowe** - International journal of computer vision, 2004 – Springer
- Optical Flow & HOG
  - Chapter 5, Fundamental of Computer Vision
  - Chapter 8, R. Szeliski: Computer Vision: Algorithms and Applications
  - Navneet Dalal and Bill Triggs “Histograms of Oriented Gradients for Human Detection” CVPR05
- Pyramids
  - Section 4.5, Fundamentals of Computer vision
  - The Laplacian Pyramid as a compact code, Burt and Adelson, IEEE Trans on Communication, 1983.

# Reading Material

- Motion Models
  - Chapter 1, Fundamental of Computer vision
- Global Motion Estimation
  - J. Bergen, P. Anandan, K. Hanna, and R. Hingorani, “Hierarchical Model-Based Motion Estimation”, ECCV-92, pp 237-22.
  - Steve Mann, and Rosalind W. Picard, *M*, “Video Orbits of the Projective Group: A Simple Approach to Featureless Estimation of Parameters, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 6, NO. 9, SEPTEMBER 1997.

# Reading Material

- KLT
  - SIMON BAKER AND IAIN MATTHEWS, “Lucas-Kanade 20 Years On: A Unifying Framework”, IJCV, 2004.
  - Section 8.2, Richard Szeliski, "Computer Vision: Algorithms and Application".

# Reading Material

- Camera Modeling and Calibration
  - Chapter 1, Fundamentals Of Computer Vision
  - Chapter 6, Introductory Techniques, E. Trucco and A. Verri, Prentice Hall, 1998.
- Fundamental Matrix
  - Richard I. Hartley, “In Defense of the Eight-Point Algorithm”, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 19, NO. 6, JUNE 1997.
- Stereo
  - Fundamentals of Computer Vision
    - 6.2.1, 6.2.4 and 6.2.5
  - Computer Vision: Algorithms and Applications, Richard Szeliski
    - Chapter 11

# Reading Material

- Structure from Motion
  - C. Tomasi and T. Kanade. Shape and motion from image streams under orthography---a factorization method. *International Journal on Computer Vision*, 9(2):137-154, November 1992.
  - Computer Vision: Algorithms and Applications, Richard Szeliski, Section 7.3
- Face Recognition
  - M. Turk and A. Pentland, “Eigen Faces for Face Recognition”, *Journal of Cognitive Neuroscience*, Volume 3, Number 1, 1991.
  - Computer Vision: Algorithms and Applications, Richard Szeliski, Section 14.2 Face Recognition
  - *LDA: Introduction to Pattern Analysis*, Ricardo Gutierrez-Osuna, Texas A&M University

# Reading Material

- Hough Transform
  - Sections 4.2, 4.3 Fundamentals of Computer Vision
- Bag of Words
  - Lecture slides

# Reading Material

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- C. Stauffer and W.E.L. Grimson, “Learning patterns of activity using real time tracking,” IEEE Trans. On PAMI, 22(8):747-757, Aug 2000.
- [Scene monitoring with a forest of cooperative sensors](#) by Javed, Omar, Ph.D., University of Central Florida, 2005, 175 pages.  
[http://server.cs.ucf.edu/~vision/papers/theses/omar\\_theses.pdf](http://server.cs.ucf.edu/~vision/papers/theses/omar_theses.pdf) Section 4.2
- Section 3.4: Connected Component Algorithms In Fundamental of Computer Vision