CMPEN/EE 454: Computer Vision
Fall 2012 Course Protocol

Instructor:

Bill Higgins, Distinguished Professor of EE, CSE, and Bioengineering
209F EE West
Phone: 865-0186; email: weh2@psu.edu
Office Hours: Friday 10:30AM-12:30PM or by appointment*
*I am not available before class (MWF 12:00-3:30).

Teaching Assistant:

Siddharth Advani
Office: TBD
Email: ska130@psu.edu; phone: TBD
Office Hours: TBD

Prerequisites: Math 230 or 231 or equivalent; CMPSC 121, 201 or equivalent.

Class Schedule: MWF 3:35PM – 4:25PM; 260 Willard Building

Textbooks:

1) *Computer Vision: Algorithms and Applications* ← At the bookstore also!
R. Szeliski, Upper Saddle River, Springer, 2011.
ISBN 978-1-84882-934-3.

Download for FREE at http://szeliski.org/Book/ → click on "September 3, 2010" link!

Note: On-line version is basically identical to print version, BUT page layout may differ some between the two versions. Also, PSU CAT has on-line version you can access.

2) *Machine Vision* ("JKS")
R. Jain, R. Kasturi, B.G. Schunck, New York: McGraw-Hill, 1995.

Download for FREE at:
http://www.cse.usf.edu/~r1k/MachineVisionBook/MachineVision.pdf

Home Page, Course Notes, Assignments:

Posted on our class Angel home page.

Course notes are NOT meant to be complete!

References on Reserve at Engineering Library:

Computer Vision: A Modern Approach, 2nd Edition
D.A. Forsyth and J. Ponce, Upper Saddle River, NJ: Pearson, 2012.
ISBN-10: 0-13-608592-X.

Introductory Techniques for 3-D Computer Vision
E. Trucco and A. Verri, Upper Saddle River, NJ: Prentice-Hall, 1998.
ISBN 10-13-608592-X.

Image Processing, Analysis, and Machine Vision, 3rd Ed.
M.Sonka, V. Hlavac, and R. Boyle, Toronto, Ontario: Thomson, 2008.

Machine Vision
R. Jain, R. Kasturi, B.G. Schunck, New York: McGraw-Hill, 1995.

Digital Image Processing, 3rd Ed.
R.C. Gonzalez and R.E. Woods, Upper Saddle River, NJ: Prentice-Hall, 2008.

Computer Vision: Models, Learning, and Inference
S.J.D. Prince, New York: Cambridge University Press, 2012.
ISBN 978-1-107-01179-3.

Digital Image Processing using MATLAB
R.C. Gonzalez, R.E.Woods, S.L. Eddins, Upper Saddle River, NJ: Pearson Prentice-Hall, 2004.

→ Chapter 2 posted on ANGEL – very useful for our class projects!

The Image Processing Handbook, 5th Ed.
J.C. Russ, Boca Raton, FL: CRC Press, 2007.

Canceled Classes:

- Friday 16 November (day before Thanksgiving Break!)
- Thanksgiving Break – week of 19 November

Grading:

2 In-class Exams:		
	Exam #1 – Wednesday 10 October	13%
	Exam #2 – Wednesday 7 November	13%
Final Exam (comprehensive)		
	Date TBD	26%
Written Homeworks (individual)		13%
Computer Projects (groups of 3)		35%

Assignments:

- There will be 7 written homeworks and 5 computer projects.
- Either one homework or one project is due nearly every **Friday** during the semester.
- BUT, homeworks will be due on **Wednesday** for the two weeks before the Exams
  - HW #3: due Wednesday 3 October
  - HW #5: due Wednesday 31 October
- Homeworks are to be turned in by 4PM of the due day
  to the ***Electrical Engineering East Homework Slot***
  - Homework slot is "closed for the day" after 4PM
- Project reports must be uploaded to ANGEL drop box by midnight of due date.

- No assignments will be due during the weeks of the two exams.
- Late homeworks/projects receive a **late penalty** of 15% per day, including weekends.
- Exams: Students can bring "cheat sheets" to the exams
    - 1 sheet for Exam #1, 2 sheets for Exam #2, 3 sheets for the Final.
    - Tables or other aids will be provided as needed.
    - Calculators are **not** needed.

Computer Projects:

- Protocol for doing projects and for project reports is posted on ANGEL.
- Students must form groups of **three**.
    - Email names of group members to the TA
    - Groups will be finalized after class on Wednesday 5 September
- Computer projects must be done using MATLAB.
    - Some predefined routines, such as those found in MATLAB or other libraries, **cannot** be used for the projects – these will be made clear, usually by the project descriptions.
    - Image-display and other data-presentation functions, however, can be used.
- **50%** of a project grade will be based on the report, following the given **protocol.**
- All members of the group will get the **same grade**.

Miscellaneous:

- The lecture notes serve as a *guideline* and are not intended to be complete!
- It is mandatory to read assigned sections in the textbook.
- Class attendance is required for all intents and purposes, but attendance will not be taken.
    - Much is said in class beyond the lecture notes and textbook.
- You are responsible for all material covered in class and on the assignments.

Fall 2012 Course Outline

1. (1 week) Computer Vision Overview and Class Protocol (Szeliski Ch. 1)

2. (3.5 weeks) Basic Image Properties and Image Processing (Szeliski Ch. 3; JKS Ch 1-4)
   a. Image formation, vision, color
   b. Digital image fundamentals
   c. 2D Pixel connectivity, region (shapes), region description/representation
   d. Image filtering, mask operators
   e. Fourier transform, Gaussian, scale space

3. (2.5 weeks) Image Feature Detection and Region Segmentation (Szeliski Ch. 4-5; JKS Ch. 3, 5)
   a. Point-based features, Harris corner detector, SIFT
   b. Edge and line detection; LoG and Canny operators
   c. Region (image) segmentation, region growing, split/merge
   d. Active contours (snakes)

4. (3 weeks) Single-Camera Geometry [Monocular Imaging] (Szeliski Ch. 2; JKS Ch.1, 8, 9, 12)
   a. 2D/3D Image transformations
   b. Camera model and parameters, perspective, and calibration
   c. Optics, illumination
   d. Image-irradiance equation, reflectivity

5. (2 weeks) Multi-Camera Geometry [Stereo Imaging] (Szeliski Ch. 11; JKS Ch. 11)
   a. Basic stereo, disparity calculation, correspondence problem
   b. Epipolar geometry
   c. Essential and fundamental matrices

6. (1.5 weeks) Motion (Szeliski Ch. 7-8; JKS Ch. 14)
   a. Motion (video change) detection, optical flow, aperture problem
   b. Structure from motion

7. (1.5 weeks) Exams, exam reviews, administrative items, wrap-up….