Purdue University
School of Electrical Engineering
EE637: Digital Image Processing
Class Information
Spring 2000

**Prerequisites:** EE 302 and EE 638 (or equivalent preparation)
**Lecturer:** Prof. Charles A. Bouman
Office: MSEE 348
Phone: 49-40340
E-mail: bouman
Office Hours: ??
**Lecture:** MWF 8:30-9:20AM; EE115
**Course Web Page:** **http://www.ece.purdue.edu/~bouman/ee637**

**Supplimentary Reference:**

A. K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall, 1989.

A. Rosenfeld and A. Kak, "Digital Picture Processing," volume 1, Academic Press, 1982.

**Course Objectives:**

The objectives of this course are to:

- Cover the basic analytical methods which are widely used in image processing. These include topics such as deterministic and stochastic modeling of images; linear and nonlinear filtering; and image transformations for coding and restoration.
- Cover issues and technologies which are specific to images and image processing systems. We will introduce a wide range of current technologies that are having impact in the image processing field. We will also study the related areas such as human visual modeling, and display/printing device characteristics.
- Develop experience with using computers to process images. We will use the VISE laboratory currently located in MSEE 189 to perform homework assignments and projects which use both the Matlab and C programming environment.

**Course Policies:**

There will be assigned and graded homework assignments. Homeworks will contain a mixture of analytical problems and computer assignments. In addition to the homeworks, there will be regularly assigned course projects of limited scope that must be performed by each student. Together the homework and projects will count toward 20% of your final grade.

There will be two midterm exams and a single final exam. Final grades will use the following weighting.

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|---|---|
| Homework and computer projects | 20% |
| Quizes | 20% |
| Midterm | 20% |
| Final exam | 40% |

**Tentative Course Outline:**

1. Mathematical Foundation
   (a) Continuous space Fourier transform (CSFT)
   (b) Discrete space Fourier transform (DSFT)
   (c) 2-D sampling and apperature effects
   (d) 2-D FIR and IIR filtering
   (e) Sharpening filters
   (f) 2-D random processes
2. Image topology and segmentation
   (a) 2-D neighborhoods and topology
   (b) Neighbors; causal orderings; connectedness;
   (c) Connected components
   (d) Region merging
3. Imaging Perception and Representation
   (a) Light, luminance
   (b) Contrast and contrast sensitivity functions
   (c) A simple model of achromatic vision
   (d) Gamma correction
   (e) Tristimulus model of color
   (f) Opponent model of color
   (g) Color coordinate systems
   (h) Uniform color spaces
4. Resolution convertion
   (a) Image decimation
   (b) Image interpolation
5. Image Enhancement and Filtering
   (a) Histograms and pointwise operations
   (b) Weiner and least squares filtering
   (c) Minimum weighted mean squared error filters
   (d) Nonlinear filters
6. Image Quantization and Halftoning

(a) Uniform quantization
(b) Lloyd-Max quantizer
(c) Vector quantizer
(d) Halftoning
(e) Ordered Dither
(f) Error diffusion
(g) Color quantization

7. Image Coding
    (a) Overview of lossless and lossy coding
    (b) Entropy and rate-distortion
    (c) Block truncation coding
    (d) Predictive coding
    (e) Transform coding
        i. KL transforms
        ii. 2-D DFT
        iii. Cosine transforms
        iv. QMF and Wavelet transforms
    (f) Motion compensated video coding

8. Image Reconstruction
    (a) Tomographic imaging models
    (b) Fourier slice theorm
    (c) Convolution and filtered backprojection
    (d) Iterative reconstruction methods

9. Image analysis
    (a) Edge detection
    (b) Segmentation
    (c) Classification and Pattern Recognition
    (d) Motion estimation
    (e) Ill-posed inverse problems