CMPEN/EE 455: Digital Image Processing I

Instructor

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Office Hours: Tuesday 2:00-4:00PM or by appointment

Teaching Assistant

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Prerequisites: EE 350/351 or 353; CMPSC 121, 201 or equivalent; MATH/STAT418

concurrent. **Class Schedule:** MWF 3:35-4:25 PM, 104 thomas Building

Textbook

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

Lecture Notes, Homework Assignments, Other Related Material

Will be posted on CANVAS website. Homeworks will involve both analytical problems and MATLAB exercises - learning to use the Image Processing Toolbox is a must.

Grading

Homeworks (no more than 5 total) – 40 percent
Class Project – 35 percent
Exams (ONE MIDTERM, NO FINAL EXAM) – 25 percent.

List of Topics Covered:

1. **Digital Image Processing: Introduction (2 lectures)**
   1.1 Origins and Relevance, Applications

2. **Digital Image Fundamentals (3 lectures)**
   2.1. Image elements – camera based capture
   2.2. Sampling and quantization
   2.3. Understanding image resolution
   2.4. Image Structure
      2.4.1. Edges and corners
      2.4.2. Relationship between pixels
      2.4.3. Meaningful image regions
   2.5. Basic Mathematical Tools in Digital Image Processing
      2.5.1.Linear, non-linear and logical operations on images
      2.5.2.Interpolation

3. **Basic Intensity Transforms (3 lectures)**
   3.1. Review of basic probability
   3.2. Histogram Equalization

4. **Spatial Filtering (4 lectures)**
   4.1. The mechanics of spatial filtering

4.2. Variety of mathematical representations
4.3. Smoothing and sharpening filters
4.4. Image gradient and Harris corner detection

5. Images in the Frequency Domain (8 lectures)
5.1. 2-D Fourier Transform
5.2. 2-D sampling and extensions of 1-D result
5.3. Basics of filtering in 2-D
5.4. Filtering in the frequency domain
5.5. Example applications of frequency domain image filtering

6. Image (and video) compression (4 lectures)
6.1. 2-D Discrete Cosine Transform
6.2. JPEG (and MPEG) image compression

7. Image Restoration (8 lectures)
7.1. Understanding noise probabilistically and spatially
7.2. Degradation models
7.3. Denoising: Spatial domain methods, Frequency and wavelet domain methods
7.5. Deblurring: Inverse filtering, Weiner, modern methods

8. Color image processing (6 lectures)
8.1. Color Fundamentals
8.2. Color spaces and device gamuts
8.3. Color Transformations and Correction
8.4. Simple color processing
8.5. Gamut Mapping: Traditional and Spatial

9. Sparsity based image processing; learning based methods

Elaboration on the class project

The class project needs you to take up an implement (in MATLAB) a practical image processing problem, e.g., compression, enhancement, restoration, retrieval, classification, in-painting etc. It is completely fine (and in fact encouraged) if you realize a well-known technique published in the literature. The idea is for you to put in action concepts learned in the class in a real practical setting. Teams of 2 are highly encouraged for the class project but not necessary.

Others: Academic dishonesty has serious consequences – do NOT indulge in the same.