

Introduction to EE637 Digital Image Processing I

- Prerequisites:
 - EE301 - Undergraduate signals and systems
 - EE302 - Undergraduate probability
- Course Objectives:
 - Learn analytical methods of image and 2-D signal processing.
 - Learn techniques commonly used in image processing.
 - Develop experience in using computers to process images.
- Course Text (optional):
 - Al Bovik editor, *Handbook of Image & Video Processing*, Academic Press, San Diego.
- Supplementary references:
 - 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 Structure

1. Course web page

- <http://www.ece.purdue.edu/~bouman/ee637>
- Contains class notes, laboratories, homeworks, and exams

2. Lectures emphasize topical coverage

- Print out course notes **before** lecture
- Lectures cover details of analytical methods

3. Laboratories and homeworks emphasize practical application

- Should be performed **independently** by students.
- Require Netscape, Acrobat, Matlab, and ANSI C compiler.

Overview of Laboratories Assignments

1. Image Filtering
2. 2-D Random Processes
3. Neighborhoods and Connected Components
4. Pointwise Operations and Gamma
5. Introduction to Colorimetry
6. Image Restoration
7. Image Halftoning
8. JPEG Image Coding

What is Image Processing?

- It is more than 2-D signal processing
- It is focused on the applications requiring the processing of “images”
- It requires a complete understanding of:
 - Physical properties of imaging modality
 - * visible light, gamma rays, acoustic waves, magnetic resonance, etc.
 - Behavior of image capture devices
 - * charged coupled devices (CCD), photomultiplier tubes (PMT), gamma camera, etc.
 - Mathematics and function of image transformations and processes
 - * Frequency transforms, filters, halftoning, compression algorithms, etc.
 - Behavior of output devices
 - * CRT displays, flat panel displays, printers, etc.

Image Processing Applications

- Digital photography
 - Kodak DC280: 2.2 mega pixel; $\approx$ \$400
 - Kodak DC460C: 18 mega pixel; $\approx$ \$25,000
- Digital scanners
 - HP5370Cse flat bed scanner: 1200 dpi, 42-bit color; $\approx$ \$300
 - Howtek D4000 drum scanner: 4000 dpi 36-bit color; $\approx$ \$40,000
 - 1 page at 4,000 dpi = 6.26 Gbytes
- The internet
 - Real-time video
 - Image and video database
- Broadcast television
 - Direct satellite system (DSS) using MPEG1 and MPEG2
 - High definition television (HDTV)/digital television (DTV)
- Medical Imaging
 - Computer aided tomography (CAT)

- Positron emission tomography (PET), and single photon emission tomography (SPECT)
- Magnetic resonance imaging (MRI), and functional MRI (fMRI)
- Ultrasound
- Optical and spectroscopic Imaging
- Remote sensing
 - Multispectral ($\ll 100$ bands) and hyperspectral imaging ($\gg 100$ bands)
 - Synthetic aperture radar (SAR)
- Automation
 - Optical character recognition (OCR)
 - Manufacturing and industrial inspection