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.

4. Old exams can be used to prepare for prepare for exams

   - Will not be collected
   - Solutions are posted, but you should work the problems first.

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:

  – Physics of imaging system

  – Mathematics of imaging algorithms

  – Psychophysics of visual perception

Image Processing Applications

- Digital photography

  – Cell phone cameras: 12 mega pixel in iPhone 14

  – Single lens reflex (SLR) and portrait cameras: 36.3 mega pixel; $\approx$\$800 + lenses (Nikon D810)

- The internet

  – Real-time video

  – Image and video database

  – H.261,H.263

  – MPEG1, MPEG2, MPEG4

- Medical Imaging

  – Transmission tomography: Computed tomography (CT)

  – Emission tomography: Positron emission tomography (PET), and single photon emission tomography (SPECT)

  – Magnetic resonance imaging (MRI), and functional MRI (fMRI)

  – Ultrasound

  – Optical and spectroscopic Imaging

- Consumer Imaging

  – Night mode in Samsung Galaxy and Apple iPhone

- – Color balance and enhancement
- – Through-the-screen fingerprint detection

- Scientific imaging

  - – Nano-scale synchrotron imaging (ptychography)
  - – Electron microscopy
  - – Hyperspectal remote sensing

- Industrial Imaging

  - – Manufacturing and industrial inspection (KLA Tencor)
  - – Inspection for 3D additive manufacturing