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; ≈$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