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

  - Point and shoot cameras: 5 mega pixel; $\approx$\$400
  - Single lens reflex (SLR) and portrate cameras: 14 mega pixel; $\approx$\$5,000

- Digital scanners

  - Flat bed home scanner: 24bit, 600dpi; $\approx$\$100
  - High resolution PMT drum scanner: 4000 dpi 36-bit color; $\approx$\$10,000

- The internet

  - Real-time video
  - Image and video database (This course!)
  - H.261,H.263
  - MPEG1, MPEG2, MPEG4

- Broadcast television

  - Direct satellite system (DSS) using MPEG1 and MPEG2
  - High definition television (HDTV)/digital television (DTV)

- 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

- Remote sensing

  - Multispectral ($<<$ 100 bands) and hyperspectral imaging ($>>$ 100 bands)

  - Synthetic aperture radar (SAR)

- Automation

  - Optical character recognition (OCR)

  - Manufacturing and industrial inspection