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 Structure

1. Course web page
   - http://www.ece.purdue.edu/∼bouman/ece63700
   - 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 python, numpy 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. Multivariate Gaussian random vectors
4. Gaussian random processes
5. Neighborhoods and Connected Components
6. Pointwise Operations and Gamma
7. Introduction to Colorimetry
8. Image Restoration
9. Image Halftoning
10. JPEG Image Coding
11. Convolutional Neural Networks

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
  - iPhone 16 camera: 48MP, 24mm focal length, f/1.78 aperture
  - Large format camera: Hasselblad, Phase One (100-150MP)
  - Single lens reflex (SLR) and portrait cameras: 36.3 mega pixel; ≈$800 + lenses (Nikon D810)
- FPV video
  - 1028 HD camera: $<$ 20ms latency; $<$ 38.5 g
- 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
  - Hyper-spectral Neutron Tomography
  - Manufacturing and industrial inspection (KLA)
  - Inspection for 3D additive manufacturing