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OFFICE HRS.: TBD, any suggestions?

CLASS TIME/PLACE: Monday, Wednesday  4:30 – 5:50 P. M.
Online, Synchronous, with possible face-to-face meeting for Exams, TBD

TEXTBOOKS:
(1) Main Textbook (DIP): DIGITAL IMAGE PROCESSING, by R. C. Gonzalez and R. E. Woods, 4th or
4E/dip4e_main_page.htm (low cost versions available online for purchase)
(2) Additional Free Textbook (IPE): Image Processing for Engineers, by Andrew E. Yagle and Fawwaz T. Ulaby
from Univ. of Michigan Publishing, free e-book download, see URL:  http://ip.eecs.umich.edu/
(3) Reference (JWoods): Multidimensional Signal, Image, and Video Processing and Coding, by John W. Woods,

PREREQUISITE: The following courses or their equivalents: (1) EE3353 (Discrete-Time Signals and Systems)
and (2) EE 3384 (Probabilistic Methods). Optional additional background that would be useful:
(3) Digital Signal Processing (DSP)
(4) Biomedical Imaging or Biomedical Signal and Image Processing
(5) Computer Vision
For non-EE majors the pre-requisite can be “Mathematical Maturity” and permission from the instructor.

COMPUTER USAGE: Homeworks and computer assignments will require the use of MATLAB with the Image
Processing Toolbox (IPT). Having access or experience with other image processing or computer vision software
packages such as CVIPTools, CVIPLab, ImageJ, LabView, OpenCV, etc. is beneficial and such packages could be
used instead of Matlab in some cases for your own practice.

COURSE APPROACH: The course will follow closely the theme presented by the Main textbook and will be
complemented using the other two textbooks (see class Lecture Notes). You should have a PAPER copy of the Main
textbook for in-class open-book Exams (in case of face-to-face course offering). Graduate students will be required to do a project with a presentation and final report. Undergraduates taking this course will be allowed to skip the Project and finish the course early by approximately 2 weeks.

**GRADING (tentative): UG=undergraduate students; Grad=graduate students**

- **Exams 1 and 2:** during class time, partially oral, at UTEP or similar arrangement: 60%
- **Homeworks and computer assignments:**
  - 20% UG; 25% Grad
- **Final Project (graduate students only):** 15%
- **TOTAL:** 100% (80% maximum for UGs)

* We will provide to students who may not be able to participate in the synchronous lectures or the face-to-face activities.

**PROPOSED TOPICS FROM THE MAIN TEXTBOOK, ORDER MAY CHANGE (topics from additional textbooks to be incorporated gradually)**

I- **DIGITAL IMAGE FUNDAMENTALS** (parts of Chapter 2, a quick start): visual perception, image acquisition, image sampling and quantization, pixel relationships, Intro. to mathematical tools used in DIP, etc.

II- **INTENSITY TRANSFORMATION AND SPATIAL FILTERING** (parts of Chapter 3): gamma correction, histogram equalization and matching, spatial convolution, filter masks, image sharpening, Gabor filters, Intro. to bilateral filtering (supplement) etc.

V- **COLOR IMAGE PROCESSING** (parts of Chapter 6): Color models, color transformations, color corrections, processing of color images, etc.

VI- **MORPHOLOGICAL IMAGE PROCESSING** (parts of Chapter 9): Basic operations on binary images such as: *dilation, erosion, opening and closing*, various applications of morphological filters, etc.

VII- **IMAGE SEGMENTATION** (parts of Chapter 10): Edge detection and linking, thresholding, region-based segmentation, clustering and superpixels, morphological watershed segmentation, etc.

VII- **FEATURE EXTRACTION** (parts of Chapter 11): binary image feature, region features, texture features, corner detection, etc.

**III- FILTERING IN THE FREQUENCY DOMAIN** (parts of Chapter 4): Fourier transform of 2-D signals and sampling, the DFT in 1-D and 2-D and properties, image smoothing and sharpening in the frequency domain, frequency domain features, etc.

IV- **IMAGE RESTORATION AND RECONSTRUCTION** (parts of Chapter 5): mean and order statistics filters, image degradation estimation, Wiener filtering, Intro. to regularization-based restoration (supplement)

IX- **ADDITIONAL, SPECIAL TOPICS** (basics of Fourier Imaging e.g. MRI, 2-D DSP topics based on additional textbooks: wavelets and filter-banks, 2-D filter design, etc.)

X- **GRADUATE STUDENT PROJECT:** Three possible categories of projects are envisioned:

- **Solve a problem using image processing:** identify a problem and apply image processing to attempt to solve it.
- **Further study of an image or video processing topic:** learn more and perform computer experimentations about a topic already covered in class or on a new topic.
• **Work with a recent algorithm from the literature:** find papers, read and understand, implement or find implementation, evaluate and test the algorithm, if possible improve it.