EE5372 IMAGE PROCESSING, CRN 18697, and EE4395-002 Special Topics (Fundamentals of Digital Image Processing, CRN 17808) Joint Offering in Fall 2020

Syllabus Draft V1.0, August 24, 2020, UTEP

INSTRUCTOR: Sergio D. Cabrera, Associate Professor
Dept. of Electrical and Computer Eng.
Office: Engineering Annex Room 335
Tel. (915)747-6968; ECE Dept. (915)747-5470; Fax (915)747-7871
E-mail: sergioc@utep.edu (best way to communicate)

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

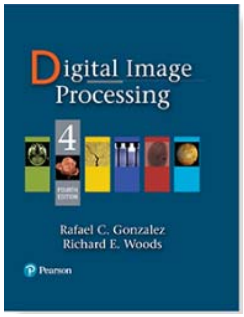
TEXTBOOKS:

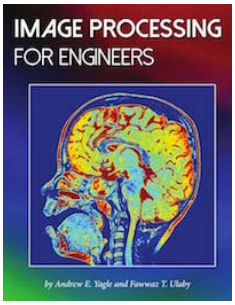
(1) Main Textbook (DIP): DIGITAL IMAGE PROCESSING, by R. C. Gonzalez and R. E. Woods, 4th or International 4th Edition from Pearson Prentice-Hall, URL: http://www.imageprocessingplace.com/DIP-4E/dip4e_main_page.htm (low cost versions available online for purchase)

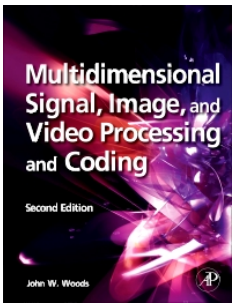
(2) **Additional Free Textbook (IPE)**: Image Processing for Engineers, by Andrew E. Yagle and Fawwaz T. Ulaby from Univ. of Michigan Publishing, free e-book download, see URL: http://ip.eecs.umich.edu/

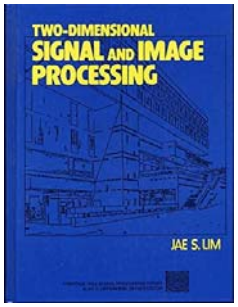
(3) **Reference (JWoods):** Multidimensional Signal, Image, and Video Processing and Coding, by John W. Woods, Academic press, 2011.

(4) **Classic Reference (Lim):** Two-Dimensional Signal and Image Processing, by Jae S. Lim, Prentice-Hall, 1990.









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.