EE5372 IMAGE PROCESSING, CRN 18951

Syllabus Final Version, August 22, 2021, UTEP

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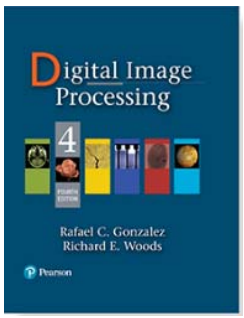
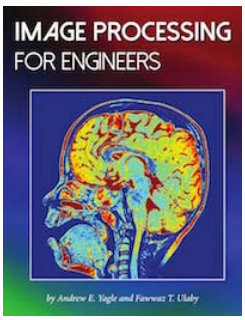
OFFICE HRS.:

Monday, Wednesday in my Office Eng. Annex A306:	12:00 PM – 12:45 PM
Tuesday, Thursday **online in EE5372 Blackboard course room**	1:30 PM – 2:30 PM
Friday in my Office Eng. Annex A306	11:00 AM – 12:00PM
(send e-mail to confirm Friday availability)	

CLASS TIME/PLACE: **Monday, Wednesday 4:30 – 5:50 P. M.**
CRBL Room C302 (in person)

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/
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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 is beneficial and such packages could be used instead of Matlab in some cases for your own practice. Examples are: *CVIPTools, CVIPLab, ImageJ, OpenCV*, etc.

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 (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%**
Final Project **(Grad students only)**	**20%**
TOTAL	100 % **(80% maximum for UGs)**

ABOUT 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.

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): basics of 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.

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

IV- 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.

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

GRADUATE PROJECTS CAN START AT THIS POINT, MORE TOPICS ARE LISTED NEXT BUT NOT ALL OF THEM WILL BE COVERED.

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

VII- 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.

VIII- 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.)