ECE5331 IMAGE PROCESSING (new number)
Syllabus V1, Fall 2023
Updated August 31, 2023, UTEP

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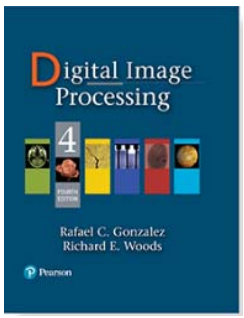
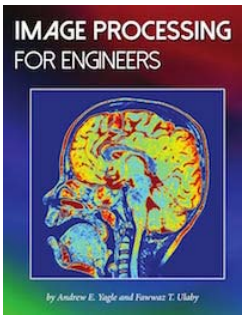
OFFICE HRS.: **OFFICE HRS.:** Tuesday, Thursday **11:30 AM – 12:20** and **1:10 – 2:00 PM**
Office in Eng. A306 Friday: 11:00 AM – 12:00PM (send e-mail to confirm my availability)

CLASS TIME/PLACE: **Monday, Wednesday 4:30 – 5:50 P. M.**
(Health Sciences HSSN 216)

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 includes: Digital Signal Processing (DSP); Biomedical Imaging or Biomedical Signal and Image Processing; Computer Vision; etc. 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 other 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.

GRADING:

Exams 1-2 or 1-3: during class time, at UTEP or similar arrangement:	**60% or 75%**
Homeworks and computer assignments:	**25%**
Final Project – Tentative but subject to cancellation in favor of additional topics and Exam 3	**15% or 0%**
TOTAL	**100 %**

ABOUT THE 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

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.

MORE TOPICS TIME PERMITTING OR SUITABLE FOR SELF-LEARNING BACKGROUND FOR THE PROJECT.

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

VIII- IMAGE RESTORATION AND RECONSTRUCTION (parts of Chapter 5 and supplements): mean and order statistics filters, image degradation estimation, Wiener filtering, Intro. to regularization-based restoration (supplement); Deep Learning Networks for image reconstruction/restoration.

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.)