Spring 2024

ECE 513
Digital Image Processing

Prerequisites: ECE 312 and ECE303 or ECE512 (preferred).

Class Hours & Place: TR 2:00-3:15 p.m, Weber 202

Reference *Book:* "Digital Image Processing", R.C. Gonzalez and R.E. Woods, 4th Edition, Pearson, 2018.

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Office Hours: 2:00 -3:30 p.m. Wednesdays

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Objectives:
The objective of this course is to introduce the students to the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images. Particular emphasis will be placed on covering methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition. In addition, the students will learn how to apply the methods to solve real-world problems in several areas including medical, remote sensing and surveillance and develop the insight necessary to use the tools of digital image processing (DIP) to solve any new problem.

Course Outline:
1. Review and Introduction: Introduction to the DIP areas and applications.
2. Image Digitization: Sampling and quantization.
3. Image Transforms: 2-D DSFT and 2-D DFT, 2-D discrete cosine transform (DCT), 1-D and 2-D Karhonen Loeve (KL) or principal component analysis (PCA) and applications to face recognition, and 1-D and 2-D discrete wavelet transforms and relation to filter banks.
4. Image Enhancement: Point and algebraic operations, edge detection and sharpening, filtering in the spatial and transformed domains.
5. Image Restoration: Degradation models, inverse and pseudo-inverse filtering, 2-D Wiener filtering and implementation.
6. Image Compression and Encoding: Entropy-based schemes, Transform-based encoding, Predictive encoding and DPCM, Vector quantization, Huffman coding.
7. Feature Extraction and Segmentation: Contour and shape dependent feature extraction, textural features, region-based and feature-based segmentation.
8. Pattern Classification: Standard linear and Bayesian classifiers, supervised vs unsupervised classification, classification performance index.
9. Applications in satellite, sonar, radar and medical areas.

Grading and Exams:

Homework	20%
Computer Assignments □	50%
Final Project ♣	30%

□There will be several computer assignments dealing with applications of a number of selected DIP algorithms.

♣A list of several possible final project topics will be provided a few weeks after the semester starts. These topics are different from those of the computer assignments. Every student should submit a one-page proposal by mid-March to discuss the topic and work plan for the proposed project. Every student should prepare a final project report (75%) and deliver an oral presentation (25%) during the last week of the semester.

Important Notes:

1. Homework solutions and computer assignment reports that are based on collaborative efforts with other students will not be graded.
2. The use of online solution/tutor websites and content is **not permitted** for the reference or completion of any graded content in this course.