

ECE 595-81 (CRN 4886)
Image Processing and Computer Vision with Deep Learning

Department of Electrical and Computer Engineering
University of Dayton

COURSE INFORMATION
Summer 2023 (*June 26 – August 05, 2023*)

Instructor: Dr. Jiji Victor Charangatt
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Lectures: Monday/Wednesday/Friday **4:00 pm – 6:15 pm**
Location: TBD

Course Objectives:

This course will focus on traditional as well as deep learning-based approaches for image processing and computer vision. The course will begin with classical image processing approaches like image enhancement and restoration where histogram-based methods, spatial filtering and edge detection methods followed by fundamental approaches for image restoration like least square filtering and MAP estimation-based techniques will be discussed. This will be followed by computer vision topics like classification, detection and segmentation using conventional feature-based approaches. Following this, deep neural networks using CNN, generative networks and attention transformers will be discussed in detail which will include laboratory sessions using PyTorch. Towards the end of the course recent deep network architectures using the above three methodologies for image processing (image deblurring, denoising, dehazing, super resolution, etc.) and various computer vision tasks (classification, detection, and segmentation) will be covered.

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Detailed Course Plan:

1. Conventional Image Processing (8 Hours)

- 1.1 Introduction
- 1.2 Mathematical Preliminaries
- 1.3 Image Enhancement
 - 1.3.1 Histogram Processing
 - 1.3.2 Spatial Filtering
 - 1.3.3 Edge Detection
- 1.4 Image restoration
 - 1.4.1 Inverse Filtering
 - 1.4.2 Wiener Filtering
 - 1.4.3 MAP Estimation

2. Introduction to Computer Vision (8 Hours)

- 2.1 Image Features
- 2.2 Classification
- 2.3 Detection
- 2.4 Segmentation
- 2.5 Introduction to 3D Reconstruction

3. Deep Learning Methods (8 Hours)

- 3.1 Introduction
- 3.2 CNN based Architectures
- 3.3 Generative Networks
- 3.4 Attention Transformers

4. PyTorch Tutorial (4 Hours)

5. Image Restoration using Deep Networks (6 Hours)

- 5.1 Deblurring
- 5.2 Denoising
- 5.3 Dehazing
- 5.4 Image Super Resolution

6. Computer Vision with Deep Learning (6 Hours)

- 6.1 Image Classification
- 6.2 Object Detection
- 6.3 Instance Segmentation
- 6.4 Vision Transformers and Applications.

Evaluation Policy

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| 1. Quizzes (2): | 10% | |
| 2. Homework Assignments (2): | | 10% |
| 3. Programming Assignments (2): | | 20% |
| 4. Term Project: | 40% | |
| 5. Final Exam: | 20% | |