



Image and Video Processing

Overview

Yao Wang
Tandon School of Engineering, New York University

Image Processing vs. Computer Vision

- Image/video processing
 - Low level processing to
 - Enhance original data (denoising, contrast enhancement, increase sampling rate, deblurring, stabilization)
 - Compression: to reduce the data rate for storage/transmission
- Computer vision
 - High level processing to
 - Detect and classify objects, Semantic level segmentation
 - Recover 3D structure/scene from 2D
- In between (Intermediate level)
 - Feature detection, low level (color based) segmentation
 - Image alignment (generating panoramas, image registration)
 - Motion estimation (to enable video compression, object tracking, object detection)
 - Depth estimation (to enable 3D reconstruction from stereo)
- This class will focus on low and intermediate level

Applications

- Social media and entertainment (content creation, delivery, and presentation)
- Visual Communications (video chat and conferences)
- Medical Image analysis (tissue/organ/tumor segmentation, image alignment, change detection)
- Robotics (recognizing objects, mapping the environment)
- Law Enforcement (deblurring of video, face detection and recognition, license # recognition, fake media detection)
- Education/training (online teaching, video tutorials)
- Advertising
- ...

Breakdown of the Course

- Image processing basics
- Video processing basics
- Feature extraction
- Image alignment and stitching based on feature correspondence
- Stereo and multiview image/video basics
- Image and video compression
- Deep learning based image processing and classification
- Both theory and practical implementation in python
- See Syllabus for more details.

Class Requirement

- Weekly lectures
- 2 tutorials related to programming
- Weekly written homework: Not graded. Solution will be provided.
- Bi-weekly quizzes based on written homeworks (40%)
 - To encourage you to review the lecture material, many are not covered in programming assignment. Quiz will be based on written HW problems.
- Six programming assignment (in Python) (30%)
 - We will provide partially completed Jupyter notebooks to guide you. You can either complete the Jupyter notebooks, or write your python code from scratch to challenge your self!
- Team Projects (30%)
- No exam
- Lots of work but you will learn a lot and you can do it!

Class Attendance

- In-person session: you are expected to attend in-person. Join via zoom when you cannot attend in person.
- INET session: synchronous remote attendance via Zoom is encouraged unless you are in a different time zone
 - Help your time management and your concentration
 - Get your questions answered right away
 - Turn on your cameras if possible so we can see each other
 - Feel free to interrupt and ask questions during the lectures

Homework

- Written HW will be assigned after each lecture but will not be graded. Solution will be provided. You should try to review the lecture material and do the problems yourself before checking the solution. Quizzes will be based on the written HW.
- Programming assignment will be due as posted and will be submitted through NYUclasses. The assignment is typically given 2 weeks ahead of due time. Each assignment counts for 10 points.
- Late submission of programming assignment will be accepted up to 3 days late, with 2 pt deduction for each day.
- Students can work in teams, but you must submit you **own** solutions.
- If there are special circumstances that make it hard you to complete in time, please email me to discuss alternatives.

Quizzes

- Quizzes will be held approximately biweekly, in lieu of exams.
- Quiz problems will be similar to the written HW problems.
 - Two problems per quiz, 15 minutes.
- Quiz will be conducted towards end of the lecture time:
 - In person students do it in the classroom, and upload your solution before the closing time.
 - Remote students will do it online, but must keep your camera on, and upload the solution before the closing time
 - Open book, but no discussion/online chat with others and web browsing
 - Please make every attempt to attend the quiz at the scheduled time! No make up allowed unless in extraordinary situations.
 - There will be separate arrangements for students in very different time zones.

Project

- Team Projects
 - 2 to 3 people in a team: bigger scopes expected for a larger team. Each member should be primarily responsible for some of the tasks.
- Project topics:
 - A list of suggested topics is given, each with a mentor (my PhD students and class TAs) assigned. They are there to help you.
 - If you want to work on a project outside the list, please speak to me. I may be able to find a mentor for you.
 - You would need to self-study for the chosen subject, which may not be covered until later in the class. Some suggested topics are not covered in the class.
- Four deadlines
 - Determine project team and project topics and submit preliminary proposal (week 3)
 - Submit final project proposal (should have read some papers and have a project plan) (week 5)
 - Submit midterm project report (Week 10)
 - Proj presentation and submit final project report (Week 15)

Office Hours

- Please come see us! We are here to help.
- Yao Wang: Mon 3:30-4:30 PM, Wed 4:30-5:30 PM (online) or appointment by email. For INET students in different time zones, please contact me to schedule special time.
- Nikola Janjusevic: Tue 11-12 PM and Fri 4-5 PM (online).
- Haoyang Pei: Mon 5-6 PM and Wed 8-9 PM (online).
- Huan Wang: Tues 4-5 PM, Thurs 9-10 AM (online)
- Zoom links in NYU classes.