Image Processing

Homework 3: Image Enhancement & Image Restoration

Due Date: 2025/11/8 23:59

Introduction

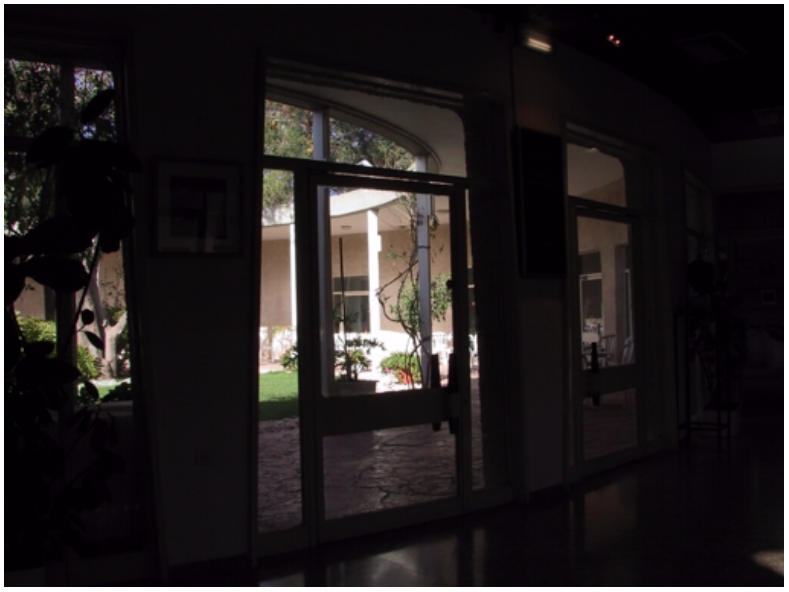
This homework focuses on image processing techniques for enhancement and restoration, aimed at improving image quality and recovering details in degraded images.

You will implement these algorithms from scratch using only OpenCV (cv2.imread(), cv2.imwrite(), cv2.cvtcolor(), cv2.line()), Numpy, and the Python standard libraries. The goal is to understand how these algorithms work and how they affect image quality.

Implementation (70%)

Task 1: Image Enhancement (25%)

In this section, the objective is to improve the visual quality and luminosity of the provided image using different image enhancement techniques.



- Implement **Gamma Correction (5%)**
    - Try at least 3 different gamma values and compare them in the report
- Implement **Histogram Equalization (20%)**

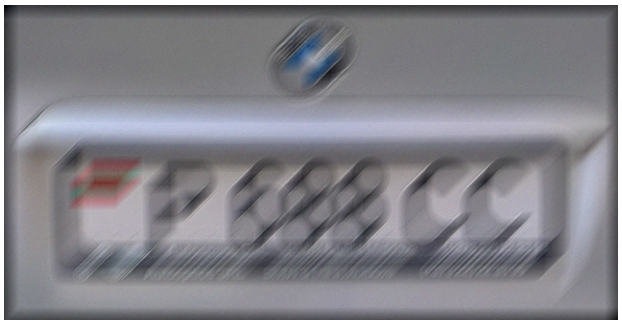
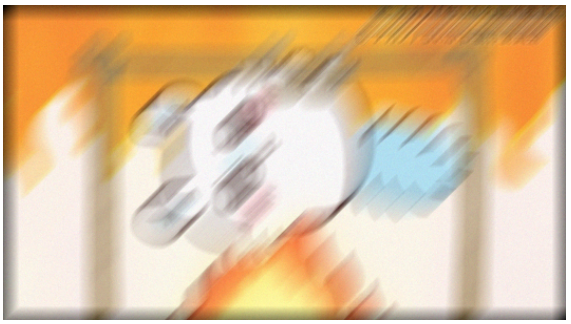
Please compare the results of these two enhancement methods in the report.

Bonus (5%): Implement any other image enhancement methods, including sharpness, saturation, contrast, etc

Please explain the implementation of the used methods and specify improvements in the image quality compared to the two enhancement methods mentioned above in the report.

Task 2: Image Restoration (45%)

In this section, the objective is to restore two degraded images provided below, labeled as testcase1 and testcase2. Both images have been degraded using the same processes, specifically Gaussian Blur and Motion Blur. This part will be graded based on visual results, i.e. the car plate should be visible in the testcase1, and the animation character should be visible in the testcase2.

To successfully restore these images, you will need to complete the following steps:

- Implement the **motion blur point spread function generation (5%)**
    - This function generates the point spread function (PSF) for motion blur with a specific length and angle as input
    - The length specifies the extent of the blur and the angle determines the direction of the blur.
    - In this homework, these two values are not given. Try to estimate the values by observing the above images.
- Implement the **Minimum Mean Square Error (Wiener) Filtering (20%)**
- Implement the **Constrained Least Squares Restoration (20%)**

Please compare the results of these two restoration methods in the report.

Bonus (5%): Implement any other image restoration methods

Please explain the implementation of the used methods and specify improvements in the image quality compared to the two restoration methods mentioned above in the report.

Requirements

- You may only use OpenCV (cv2.imread(), cv2.imwrite(), cv2.cvtcolor(), cv2.line()), Numpy, and other Python standard libraries for the implementation.
- Do not directly call packages to execute the entire algorithm; otherwise, you will receive no points.

Report (30%)

- You should write your report following the report template.
- The report should be written in **English**.
- Please save the report as a **.pdf** file.

QA Page

If you have any questions about this homework, please ask them on the following Notion page. We will answer them as soon as possible. Additionally, we encourage you to answer other students' questions if you can.

https://tonychi123.notion.site/HW3-QA-Sheet-2704c97a4022806683acd630c7560fe7

Submission

Due Date: 2025/11/8 23:59

Please compress all your code files and report (.pdf) into {student_id}_hw3.zip.

The file structure should look like:

```
📂{student_id}_hw3.zip
  ├ 📜 image_enhancement.py
  ├ 📜 image_restoration.py
  └ 📜 report.pdf
```

Wrong submission format leads to -10 points.

20% off per late day.

Please note that plagiarism is strictly prohibited, MOSS will be used to check all source codes. If confirmed, any students found cheating will receive zero points on this assignment.

The subsequent justifications for plagiarism are unacceptable:

1. **I taught my friend using my code, and I'm unsure why their work resembles mine.**
2. **We collaborated on the task, which explains its similarity.**
3. **I altered it from content on the internet, and this is the source I used.**