Laboratory Assignments: Image Filtering

Assignment 1 – Linear Filters

Objective: Understand and apply different linear filters (Mean, Weighted Average, Gaussian).

Tasks:

1. Load a grayscale image in Google Colab.
2. Apply a Mean (Box) Filter with different kernel sizes (3×3, 5×5, 9×9). Compare the results.
3. Implement a Weighted Average Filter using a custom kernel (e.g., higher weights in the center). Normalize the kernel before applying.
4. Apply a Gaussian Filter with different sigma values.
5. Write a short analysis:
    - Which filter smooths the image the most?
    - Which filter best preserves edges while reducing noise?

Assignment 2 – Non-Linear Filters

Objective: Explore median, max, and min filtering for noise removal.

Tasks:

1. Add salt & pepper noise to the input image.
2. Apply a Median Filter with kernel sizes 3×3, 5×5, and 7×7. Compare results
3. Apply a Max Filter and Min Filter. Observe their effects on bright and dark noise.
4. Discuss: Why is the median filter better for salt & pepper noise compared to mean filtering?

Assignment 3 – Correlation vs Convolution

Objective: Understand the difference between correlation and convolution.

Tasks:

1. Implement correlation filtering using `cv2.filter2D`.
2. Manually implement convolution filtering by flipping the kernel before correlation.

3. Compare outputs of correlation vs convolution with the same kernel (e.g., edge detection kernel).
4. Answer: Why do many libraries (e.g., OpenCV) use correlation instead of convolution?

Assignment 4 – Real-World Case Study

Objective: Apply filtering in a realistic scenario.

Case: A surveillance camera captures images at night, but the images contain **random noise** and **low visibility edges**. Get the image from google here is the example:

Tasks:

1. Simulate the scenario by adding Gaussian noise to an image.
2. Apply linear filters (Box, Weighted, Gaussian) to reduce noise.
3. Apply non-linear filters (Median, Min, Max) and compare results.
4. Finally, apply an edge detection filter (Sobel or Laplacian) to enhance visibility.
5. Write a short conclusion (200–300 words): Which filtering method is most effective for this case and why?