Image processing Project Report

Overview

The objective of this project is to implement various image filtering techniques to enhance and manipulate an input image. We apply four different filters to the image, save the filtered images, compute the differences between the input and filtered images, and normalize the pixel values. The project consists of:

1. Applying a 3x3 w-filter to the input image.
2. Applying a 3x3 Laplacian filter with +8 at the center to the input image.
3. Applying unsharp masking using a 5x5 Gaussian filter with σ^2 = 100 to the input image.
4. Applying a 3x3 averaging filter followed by a 3x3 Laplacian filter with -4 at the center to the input image.

In this report, we will describe the approach taken, provide results for each step, and discuss the observed effects of the filtering techniques.

Steps involved to apply each filter:

1. Apply the filter to the grayscale image.

2. Save the filtered image in a file named "filenameFilterType."

3. Compute the difference between the input and filtered images.

4. Normalize the resulting pixel values to the range [0, 255].

5. Save the normalized difference image in a file named "filenameFilterTypeDiff."

1: Applying the 3x3 w-filter

The 3x3 w-filter is applied to the grayscale version of the input image. We calculate the difference between the original image and the filtered image and normalize the result to the [0, 255] range.

2: Applying the 3x3 Laplacian filter

The Laplacian filter is applied to the grayscale image with +8 at the center. As in step 1, we calculate the difference between the original image and the filtered image and normalize the result.

3: Unsharp Masking with Gaussian Filter

We apply unsharp masking using a 5x5 Gaussian filter with a σ^2 value of 100. This filter is applied to the input image, and the difference between the original and sharpened image is computed and normalized.

4: Averaging + Laplacian Filter

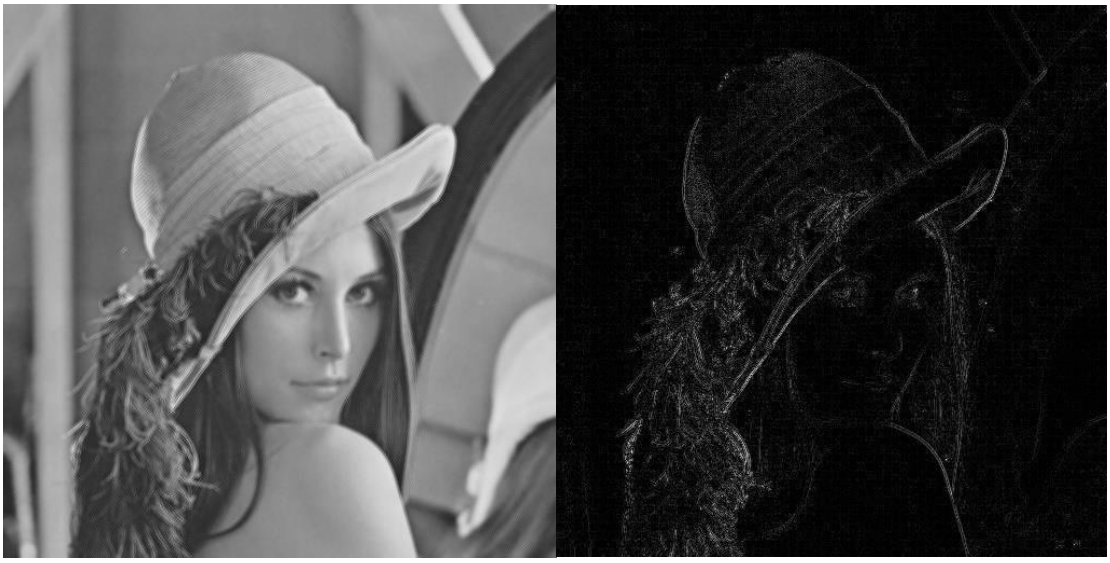
In this, we first apply a 3x3 averaging filter to the grayscale image and then apply a 3x3 Laplacian filter with -4 at the center. We compute the difference between the original image and the final filtered image and normalize it.

Results

1: 3x3 w-filter

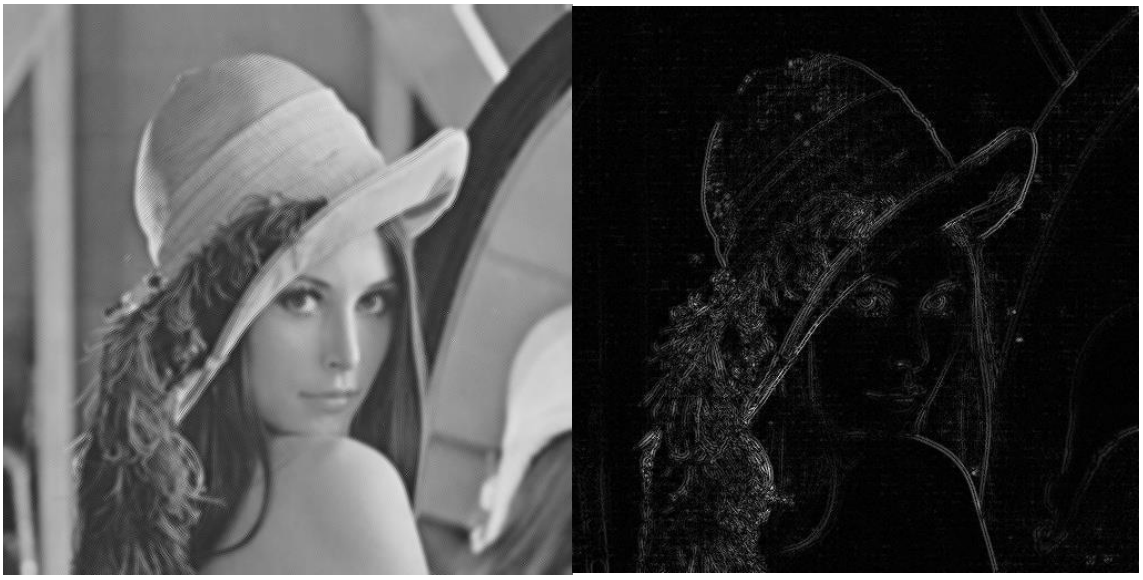
lena_grayfilter-g and lena_grayfilter-g-diff

- It emphasizes edges and fine details. It enhances the image's high-frequency components.



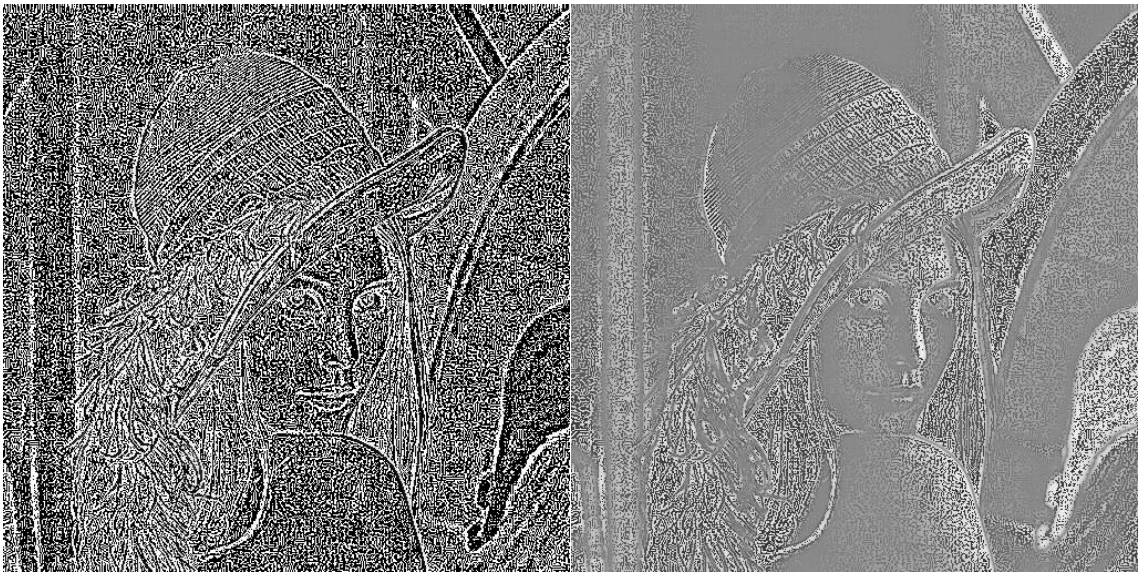
lena_grayfilter-h and lena_grayfilter-h-diff

- This further enhances edges and fine details, making them more pronounced.



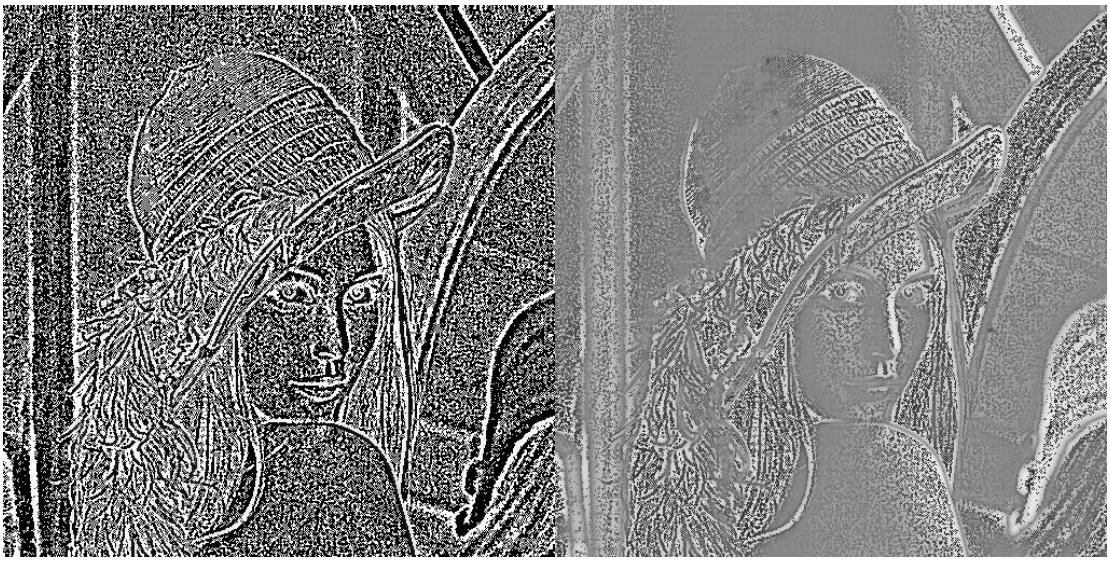
lena_grayfilter-s and lena_grayfilter-s-diff

- It represents the details that were emphasized by the w filter.



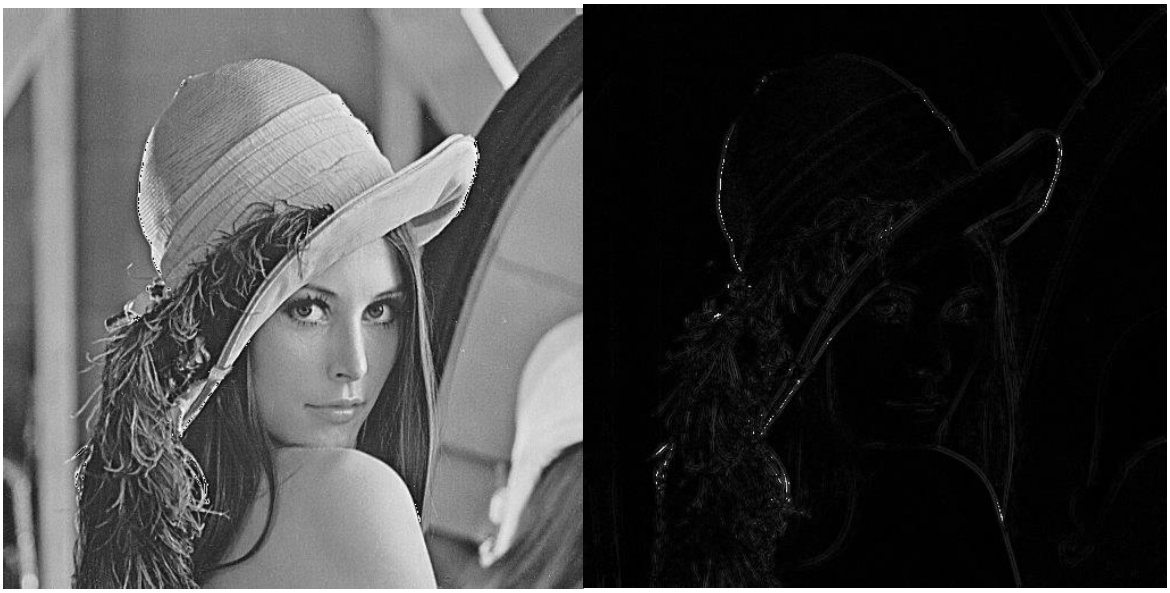
lena_grayfilter-r and lena_grayfilter-r-diff

- It represents the enhanced details obtained after applying the w filter twice.

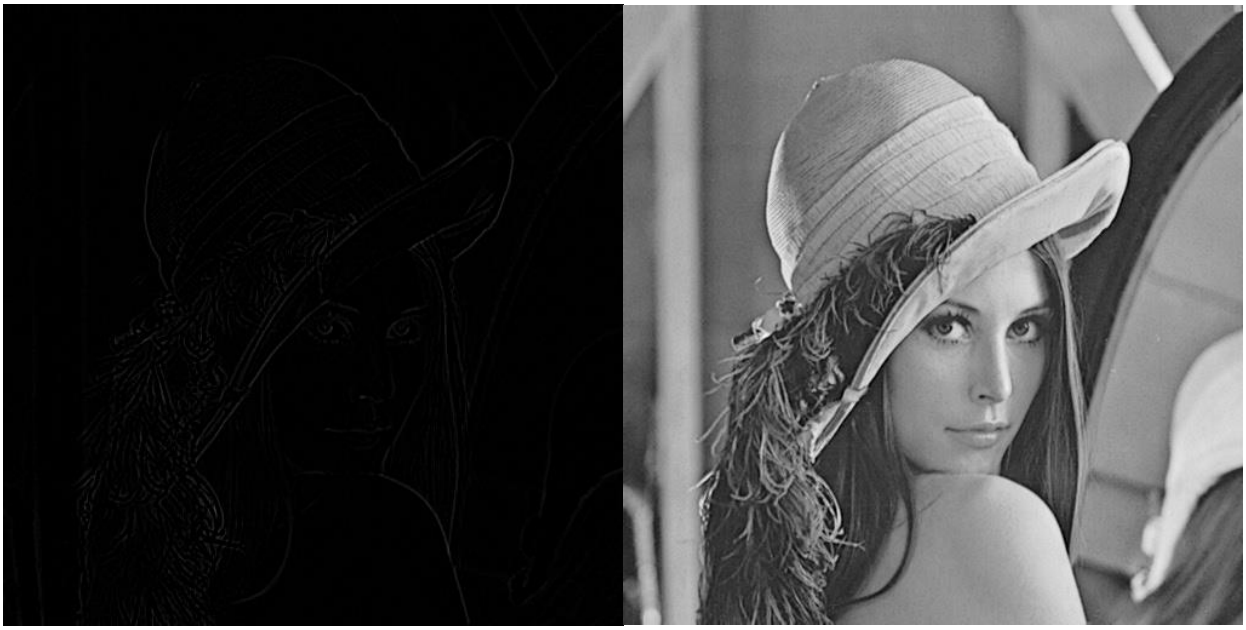


2: 3x3 Laplacian Filter

3: Unsharp Masking



4: Averaging + Laplacian Filter



Observations

- In 1, the 3x3 w-filter highlights edges and details in the image.
- In 2, the 3x3 Laplacian filter with +8 at the center enhances the edges and details in the image. The difference image shows the amplified edges.
- In 3, unsharp masking with a Gaussian filter sharpens the image. The difference image shows the sharpened details.

- In 4, applying an averaging filter followed by a Laplacian filter enhances the edges and details while smoothing the image. The difference image reflects the amplified edges and details.

Conclusion

This project successfully applied various image filtering techniques to enhance and manipulate an input image. Each step in the process provided different results, highlighting edges and enhancing details. The project helps us understand the effects of different filters and their impact on image enhancement.

Overall, the project demonstrates the power of image filtering for image enhancement and manipulation.