EE5175 - Lab 10 Report

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1 Introduction

This report presents the implementation and observations of various image processing functions in Python. The functions are applied to two input images: "krishna_0_001.png" and "krishna.png".

2 Functions

2.1 Non-Local Means Filter

The function `nlm_filter` implements a non-local means filter for image denoising. It computes weighted averages of pixel intensities based on similarities between image patches. The function takes the input image, window sizes, and Gaussian standard deviation as parameters and returns the filtered image.

2.2 Peak Signal-to-Noise Ratio (PSNR)

The function `PSNR` calculates the Peak Signal-to-Noise Ratio between two images. It measures the quality of the filtered image compared to the original image. The function takes the original image and the filtered image as parameters and returns the PSNR value.

2.3 Gaussian Kernel Generation

The function `generate_kernel` generates a Gaussian kernel for convolution operations. It computes the weights of the kernel elements based on the specified standard deviation and kernel size. The function takes the standard deviation and kernel size as parameters and returns the Gaussian kernel matrix.

2.4 Padding

The function `pad` pads the input image with zeros to accommodate convolution operations with a Gaussian kernel. It adds zero-padding around the image borders. The function takes the standard deviation and input image as parameters and returns the padded image.

2.5 Convolution

The function `convolution` performs image convolution with a Gaussian kernel. It computes the weighted sum of pixel intensities in the neighborhood of each pixel. The function takes the input image and standard deviation as parameters and returns the convolved image.

3 Implementation

The image processing functions are implemented using the OpenCV (cv2) library for image loading and the NumPy library for numerical operations. The functions are applied to the input images, and the results are analyzed.

4 Results

The implementation is tested on the "krishna_0_001.png" and "krishna.png" images using various standard deviations for Gaussian blur. The resulting images demonstrate the effects of denoising and smoothing on the input images.

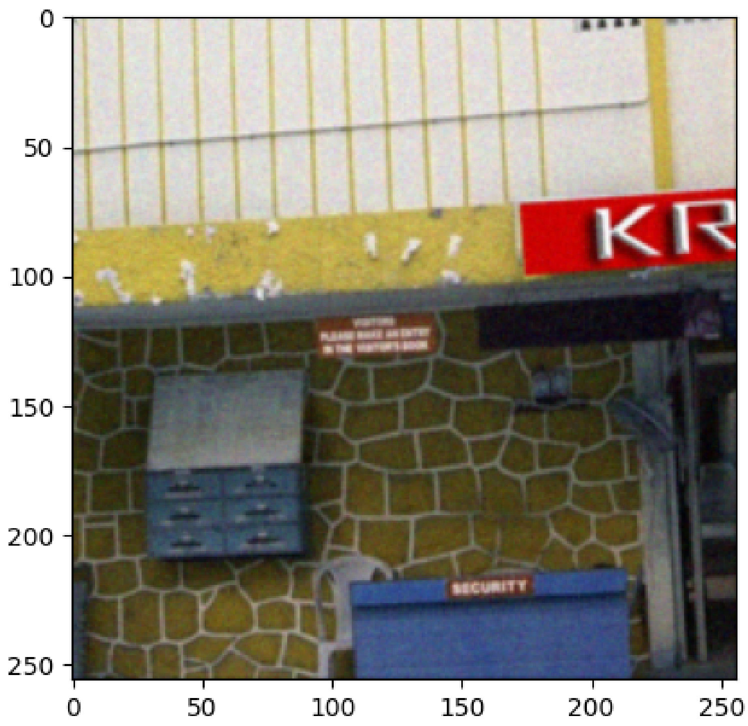


Figure 1: Filtered image

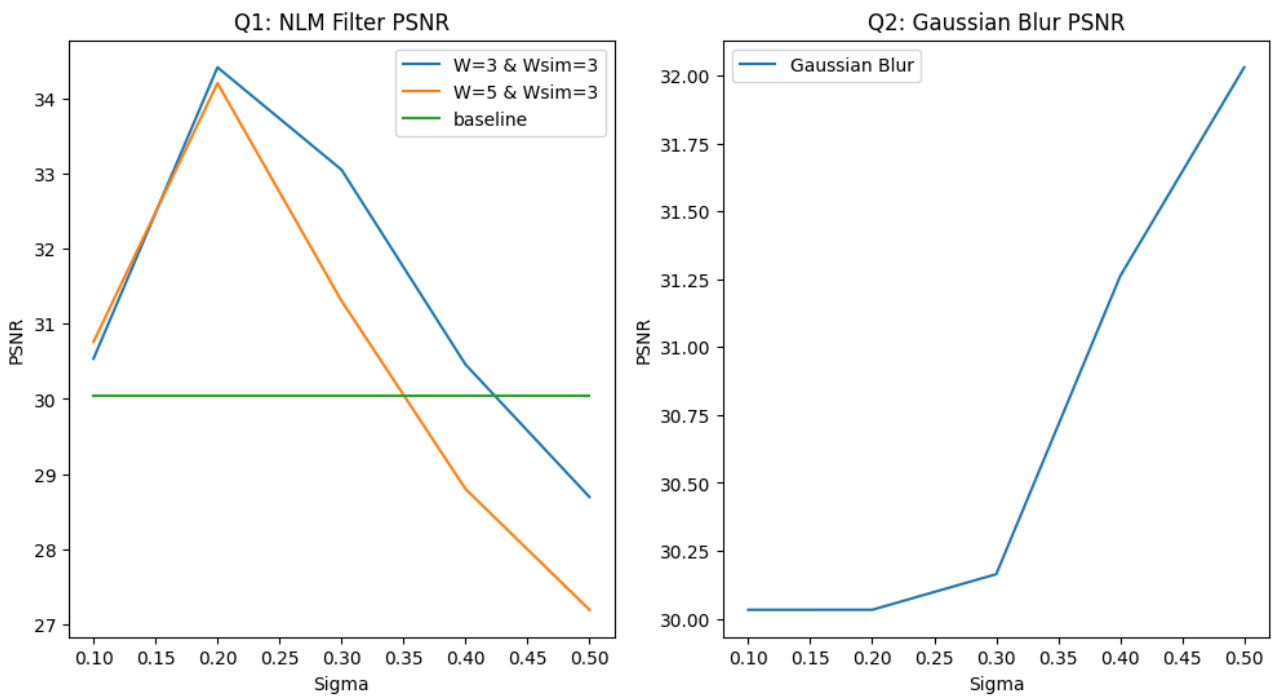


Figure 2: Comparison of PSNR values for NLM filter with different window size

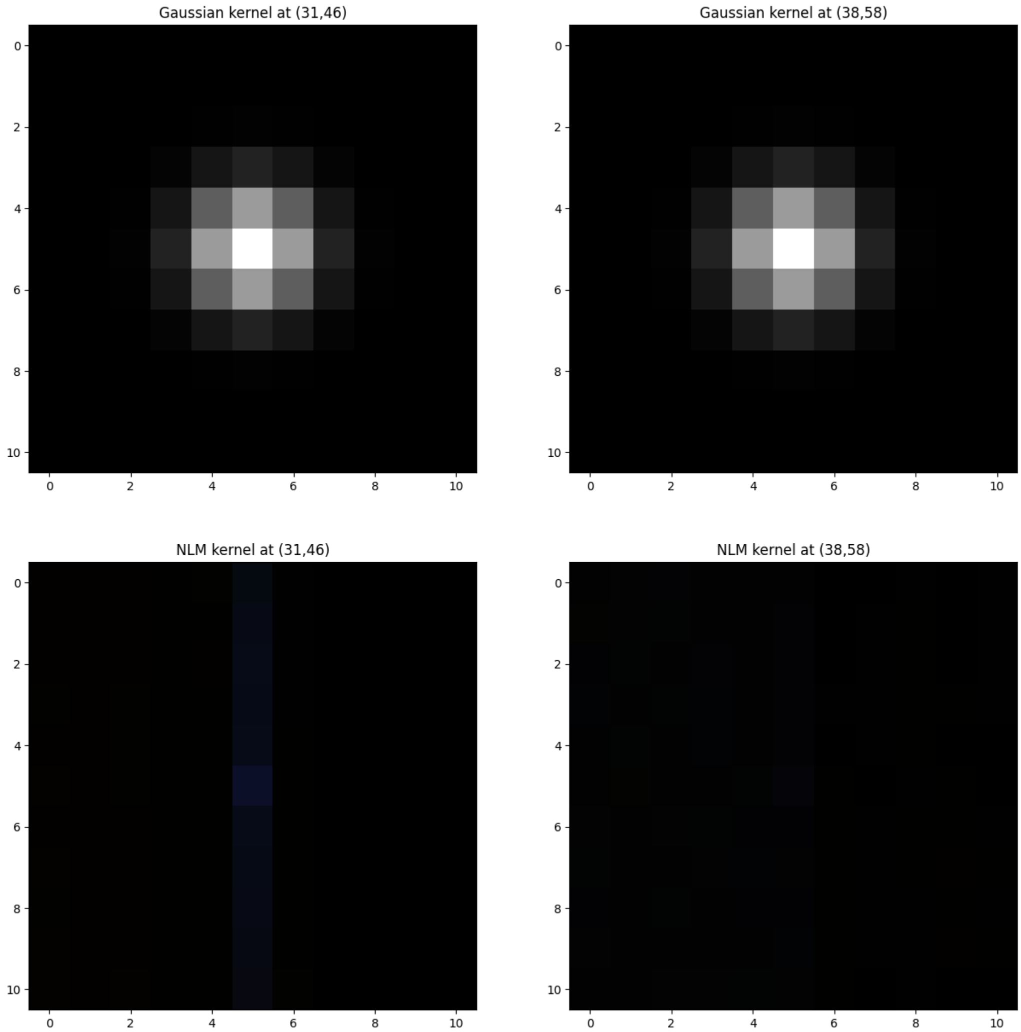
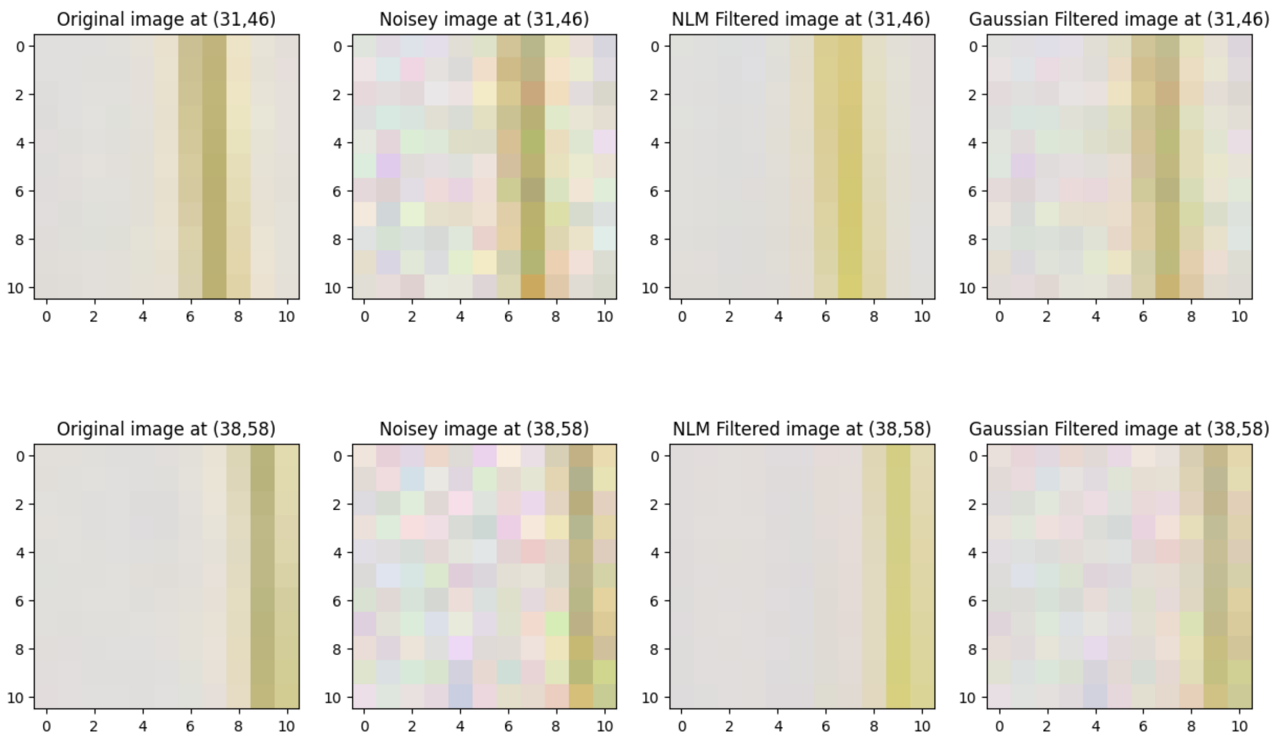


Figure 3: Kernel Comparisons at two locations



5 Conclusions

PSNR obtained by using the NLM filtering algorithm is better than that of the Gaussian filtering algorithm. When a bigger search window is used, the PSNR is better but after a particular N LM value, it falls behind.

- The Gaussian kernel is the same at both locations because it doesn't change based on where it's applied. However, the NLM kernels look different because the degree of similarity between patches varies depending on the location.
- In this experiment, the baseline PSNR (Peak Signal-to-Noise Ratio) is 30.033 dB. This measures how much noise is present compared to the original image, and it was calculated using different values of the σ_{NLM} parameter.