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Image Denoising

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Image Processing

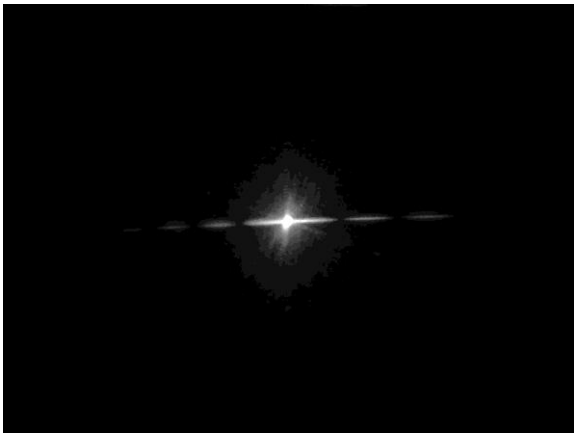
Image denoising

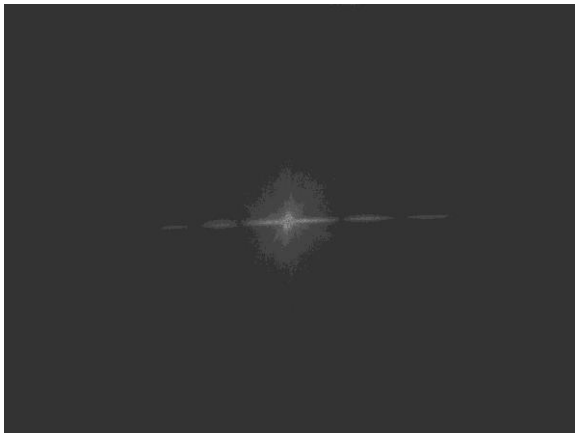
Introduction

Generate sparse Gaussian noise matrix of image size**.** Multiply grayscale image to sparse Gaussian noise matrix. Denoise the resulting image with 2D Fourier Transform and Gaussian filter.

Original image

Noisy image

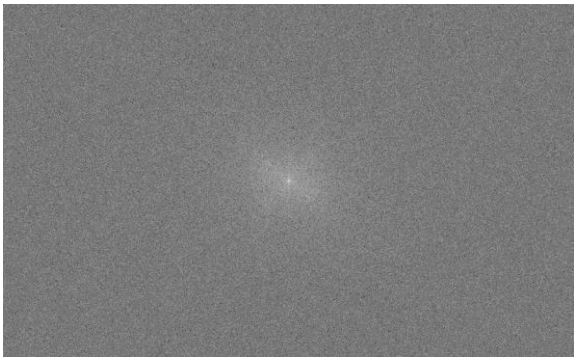




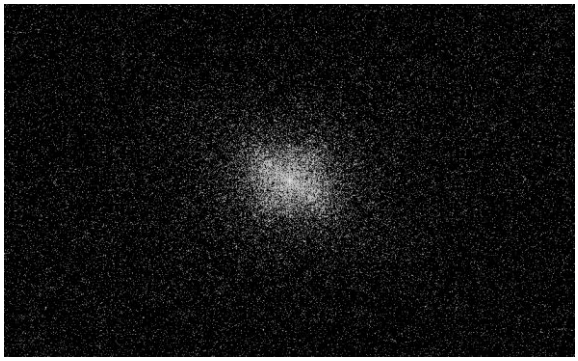
1) 2D Fourier transform

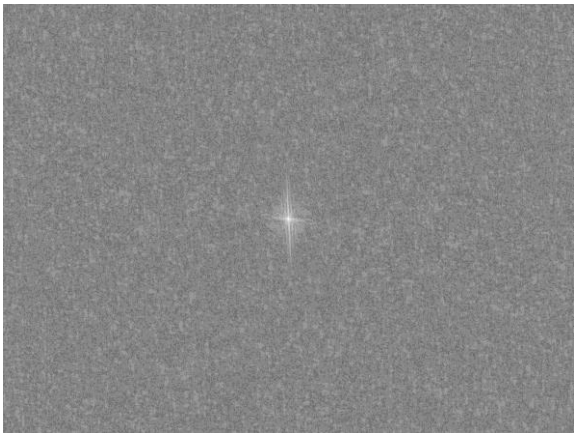
Use Fast Fourier Transform 2D (FFT2) to noisy image and shift the zero-frequency component to the center of the spectrum. Apply a mask to the transform to remove small values, exclude the noise.

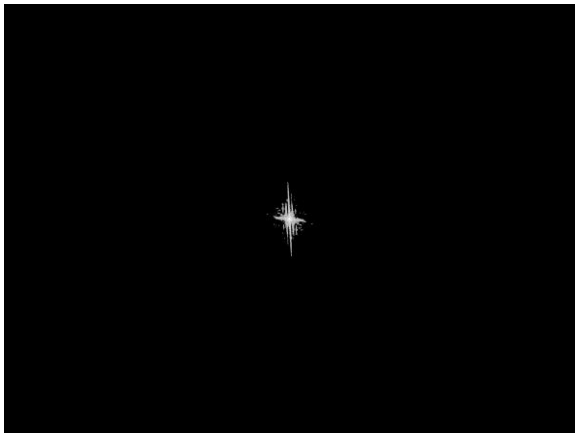
Shifted transform



Shifted transform with mask

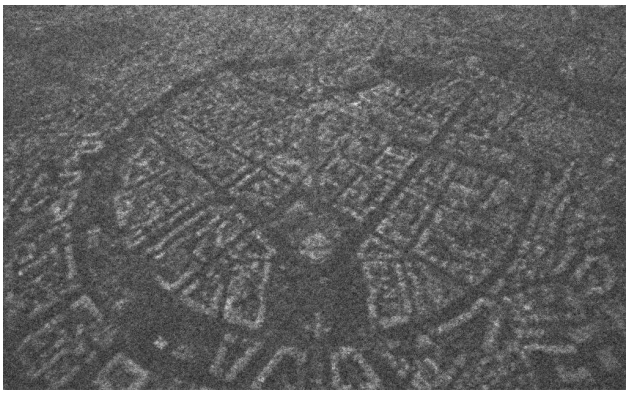


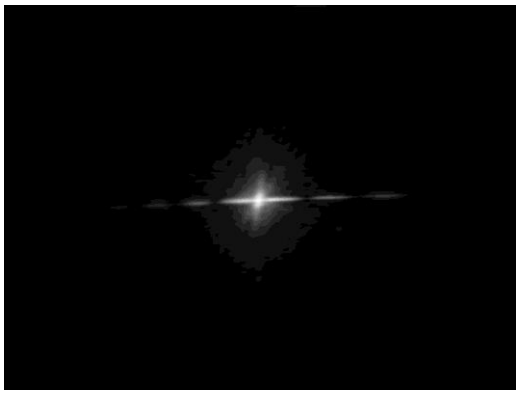




Inverse shift the masked transform and use an Inverse FFT2.

Denoised images



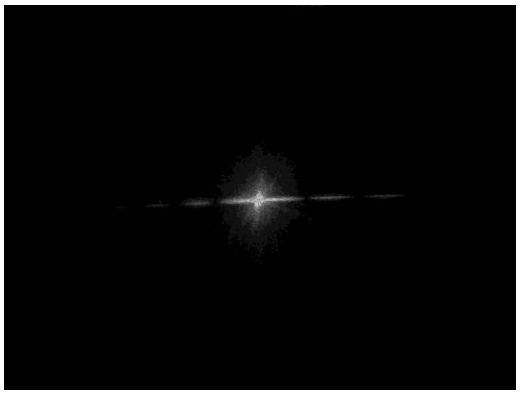


NMSE between original and noised images	1.0003686697557495	0.3510733808290644
NMSE between original and recovered images	0.2509345832050261	0.0089367510107998

2) Gaussian filter

Use Gaussian filter with 9x9 kernel size to noisy image. The resulting image will be blurred.

Gaussian filtered image



NMSE between original and noised images	1.0003686697557495	0.3510733808290644
NMSE between original and recovered images	0.9922282638709496	0.0202563520175992

Summary

The first image was filtered better with Gaussian filter than FFT, because there are a lot of structures with different colors in the first image, but in case of Gaussian filter the resulting image was blurred. The second image was filtered well with both FFT and Gaussian filters.