**ES 331 Probability and Random Processes**

**Assignment 4**

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**Aim:**

To restore a corrupt image by implementing a wiener filter.

**Theory:**

Wiener filter is used to remove blur caused due to linear motion or unfocussed optics. Let

be the uncorrupt image

be the Fourier transform of the uncorrupt image

be the point spread function

be the Fourier transform of the point spread function

be the additive noise

be the Fourier transform of the noise

be the corrupt image

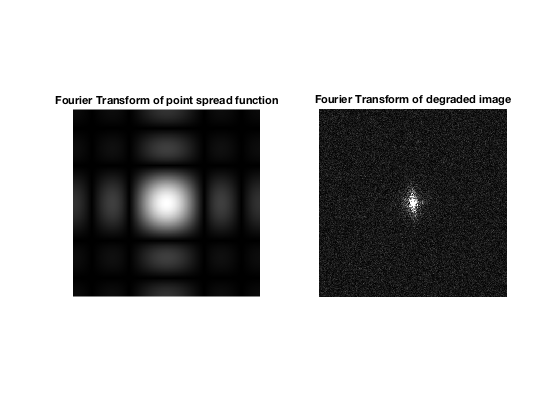
be the Fourier transform of the corrupt image

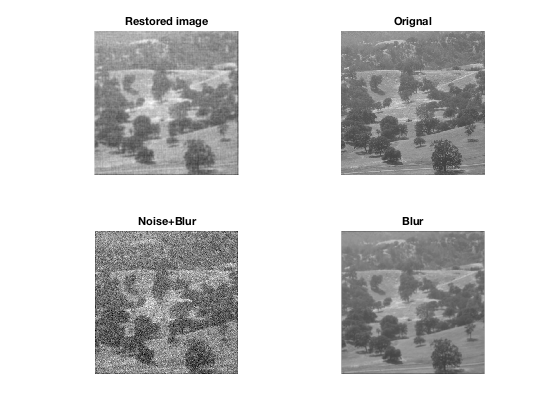
Then the following formula can be used for implementing the wiener filter.

where, is the ratio of PSD of noise and PSD of uncorrupt image

**Procedure:**

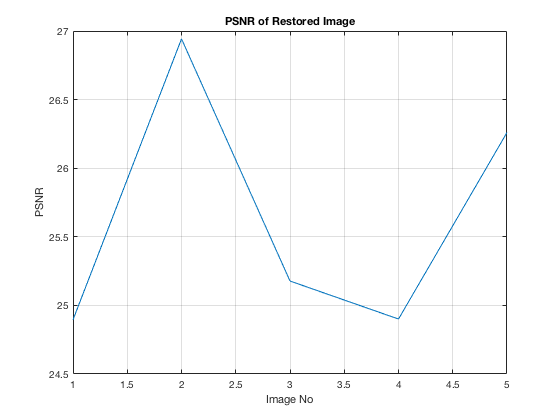
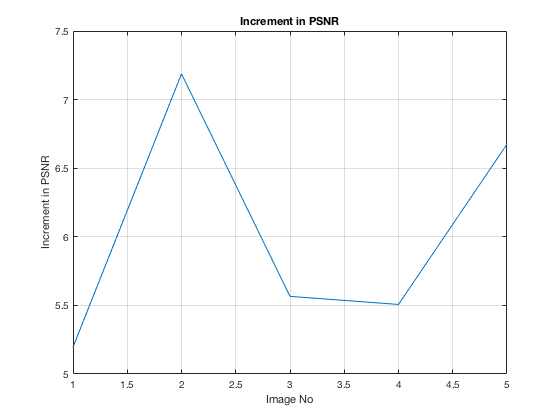
1. **Estimation of** :
   1. To estimate 10 grayscale(512x512) images were used.
   2. A gaussian blur with standard deviation of 10 and kernel size of 5x5 was applied.
   3. A additive white gaussian noise of mean of 0 and variance of 0.01 was added to the blurred image.
   4. and were calculated for each image by using the inbuilt function in MATLAB(fft2()).
   5. for each of the 10 images was calculated and the average stored for testing.
2. **Implementation of Wiener Filter:**
   1. 5 grayscale(512x512) images were used for testing.
   2. A gaussian blur with standard deviation of 10 and kernel size of 5x5 was applied.
   3. A additive white gaussian noise of mean of 0 and variance of 0.01 was added to the blurred image.
   4. The Fourier transform of the corrupt image() and the point spread function were calculated()
   5. is found by the formula above for which the used is the one estimated before.





**Results:**

|  |  |  |  |
| --- | --- | --- | --- |
| Image No | PSNR(Restored image) | PSNR(Corrupt image) | Increment in PSNR |
| 1 | 24.895062 | 19.699579 | 5.195483 |
| 2 | 26.942488 | 19.755104 | 7.187383 |
| 3 | 25.177608 | 19.611743 | 5.565866 |
| 4 | 24.900558 | 19.393619 | 5.506938 |
| 5 | 26.260437 | 19.585012 | 6.675425 |



**References:**

* Intuitive Probability and Random Processes using MATLAB
* Dataset: [Dataset of standard 512x512 grayscale images](http://decsai.ugr.es/cvg/CG/base.htm)
* [B14 Image Analysis, Andrew Zisserman, University of Oxford, Lecture 3](B14%20Image%20Analysis,%20Andrew%20Zisserman,%20University%20of%20Oxford)
* MATLAB documentation <https://in.mathworks.com>