Investigating the Effect of Motion Blur and Gaussian Noise in Image and Comparative Analysis of Various Filter for Reconstruction of Image

Gaurav Makwana¹ Maya Makwana² Jitendra Managre³ Nilesh Patidar⁴ Alka Karketta⁵
¹²³SVITS, Indore, India
⁴⁵SVCE, Indore, India

Abstract— The present work investigates the qualitative effects of the Gaussian noise in image called "Gaussian blur". Noise is inherent to the physical process of data acquisition so to analyze the image proper filtering technique is required. To do this segmentation process is helpful but it requires long time to process. To evaluate the filtering process we have analyze various type of filter for quantitative analysis of the effect of Gaussian noise to the original image. Simulation is done on MATLAB and results are shown.

Key words: Motion Blur, Gaussian Blur, Filtering, Segmentation

I. INTRODUCTION

Noise in an image can reduce the visibility of certain features within the image although undesirable appearance in image causes variation in brightness and color information in an image. This noise generally produced by wrong designing of machine or Electrical interference or due to human error or by environmental condition. Generally PET, X-ray, CT-Scan, MRI etc. are used visualize the internal organ of human body. So there are many times it is required to filter out an image like for example in brain tumor detection it might possible that tumor disappear in image due to excessive noise which gives the wrong diagnosis information.

The proposed method investigates the effect of Gaussian blur on image and filters used to minimize the effect of this noise in image.

II. PROCEDURE

The original image was taken and noise (i.e. motion blur and Gaussian noise) is added to the image and then filtered, using the Wiener filter, Regularized Filter, Lucy-Richardson Algorithm, blind de-convolution algorithm, Restoration by Estimated NSR(noise-to-signal-power ratio).

The "Gaussian Blur" involves the convolution of Gaussian function with the pixels of the image. The convolution is

\[
f(x, y) \ast h(x, y) = \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} f(m, n)h(x - m, y - n)
\]

If A is the amplitude, \((x_0, y_0)\) the center, \(\sigma_x, \sigma_y\) is the standard deviations in the x and y direction:

\[
f(x, y) = A e^{-\frac{(x-x_0)^2 + (y-y_0)^2}{2\sigma_x^2 + 2\sigma_y^2}}
\]

Convolution kernel is required for the approximation of Gaussian distribution in image processing so convolution matrix is built by this motion and Gaussian blur with original image.

The parameter that we use to define the filter is the variance of the Gaussian distribution, to calculate the quality factor.

\[
Q(f, h) = \frac{\sigma_{fh}}{\sigma_f^2 + \sigma_h^2} \cdot \frac{1}{2} \cdot \frac{\sigma_f^2 + \sigma_h^2}{\sigma_f^2 + \sigma_h^2}
\]

(3)

Where \(f\) is the original image and \(h\) is the filtered image and \(\sigma\) denotes variance.

To evaluate the noise level in image is the signal to noise ratio (SNR), given by

\[
SNR = 20 \log \left( \frac{\sigma_{signal}}{\sigma_{noise}} \right)
\]

(4)

III. RESULT

To add noise, we used the function provided by image J ("Noise" function). The first step was to measure the mean and standard deviation of the original image with the resulting images. We then used (4), to calculate the noise variance and we added the selected noise to image. The estimated NSR is 6.9480e-004.

Fig. 1: Original Image

Fig. 2: Image with Assumption That Linear Motion of a Camera
Investigating the Effect of Motion Blur and Gaussian Noise in Image and Comparative Analysis of Various Filter for Reconstruction of Image

IV. CONCLUSION

The Gaussian blur technique is particularly useful to filter images with a lot of noise, since the results of the filtering showed a relative independence on the noise characteristics. The Gaussian blur is better used when the original image has a low SNR. As we have seen the comparative analysis of various filter used to remove Gaussian noise and Lucy-Richardson Algorithm gives better SNR to remove the Gaussian noise and motion blur in image.
REFERENCE


