Computer Vision - Assignment1

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We will be working with 3 filters (3, 5, 9).

I have implemented my own Correlation, Convolution and Median filter functions. These take parameters like Image, Kernel, Kernel size, Padding and Number of channels. (RGB images have 3 channels).

I used numpy, cv2 and math libraries for my work. I padded the images with zeroes accordingly using the cv2.copyMakeBorder() function.

I created a gkern() function which create Gaussian kernels based of required size and sigma.

We will explore part 1 and part 2 of assignment. I have written my observation beneath each part.

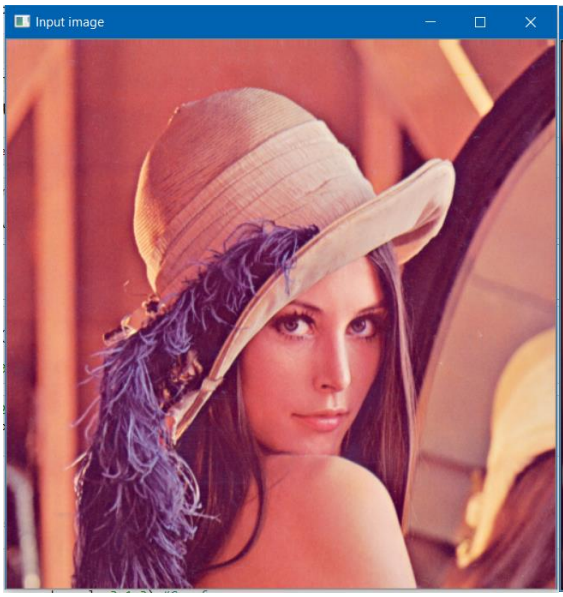
Difference between convolution and correlation:

The basic difference between convolution and correlation is that the convolution process rotates the matrix by 180 degrees. Most of the time the choice of using the convolution and correlation is up to the preference of the users, and it is identical when the kernel is **symmetrical**.

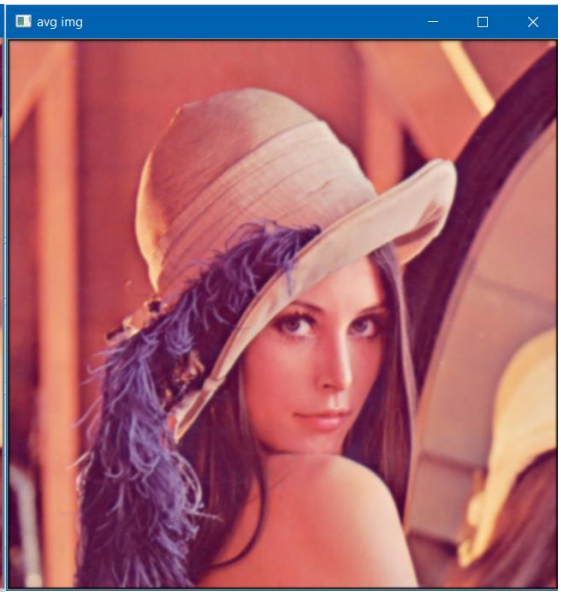
Part 1

Applying various filter of Kernel Size = 3

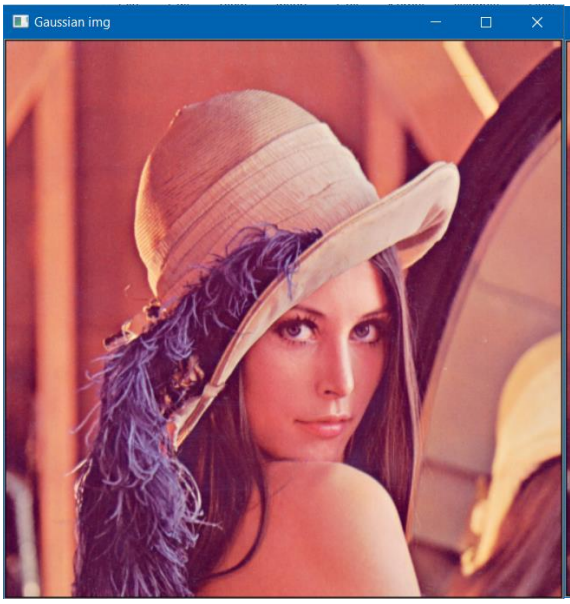
Original Image



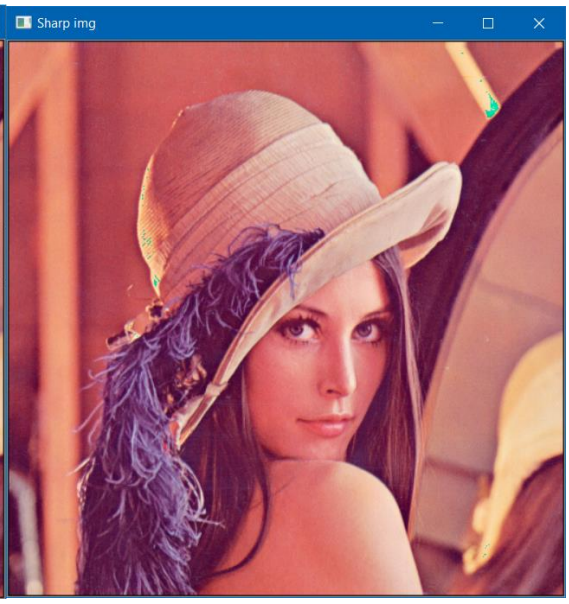
Mean Filter applied Image



Gaussian Filter applied



Sharpened Image (Original + 2*Details (Gauss))

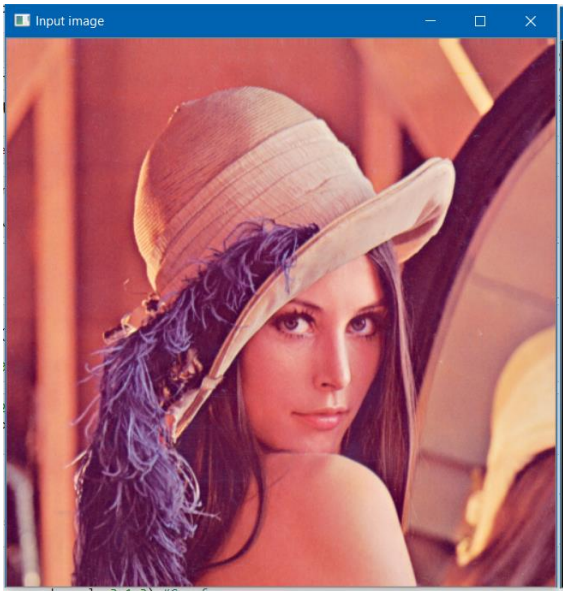


For sharpening, I used Gaussian filtered image to extract details. Then I added twice of it back to the original image.

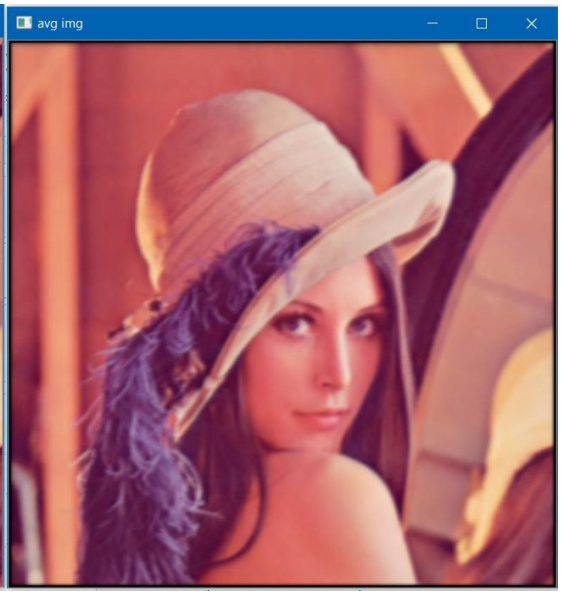
Details = Original – Gaussian , Sharpened image = Original + 2* Details

Applying various filter of Kernel Size = 5

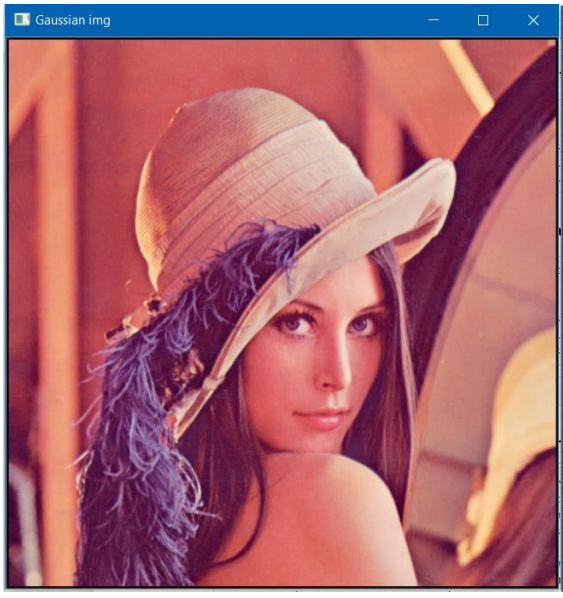
Original Image



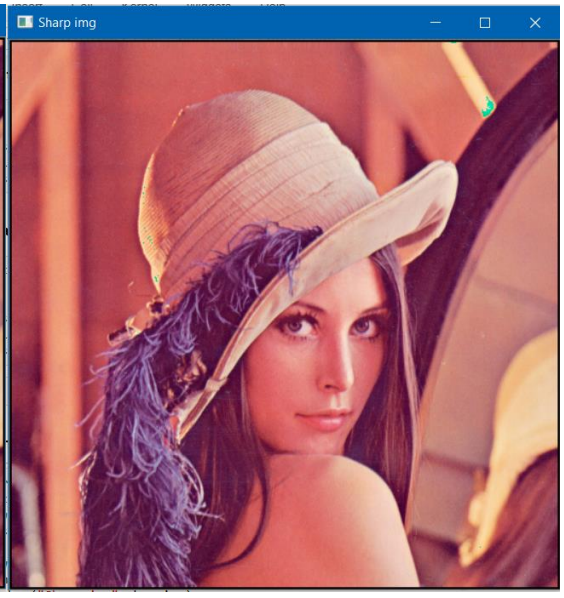
Mean Filter applied Image



Gaussian Filter applied Image



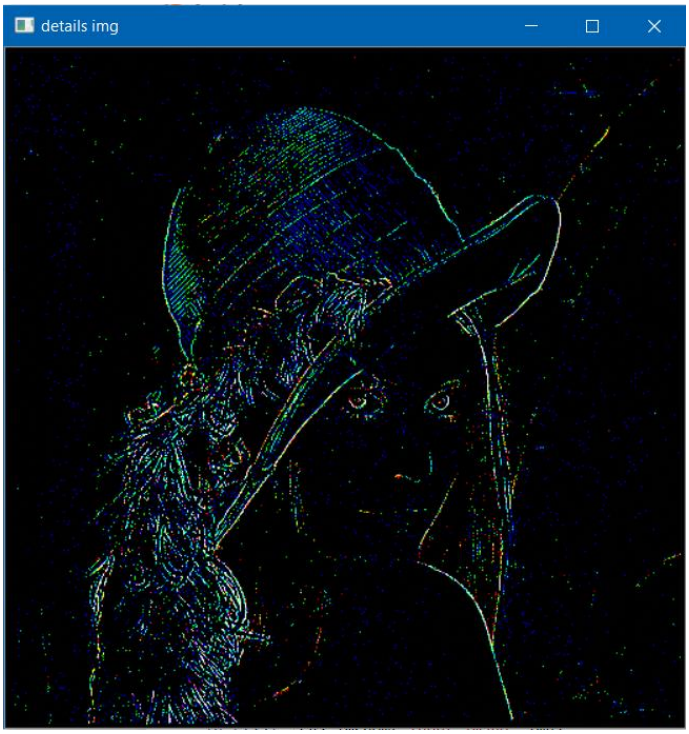
Sharpened image(added details)



For sharpening, I used Gaussian filtered image to extract details. Then I added twice of it back to the original image.

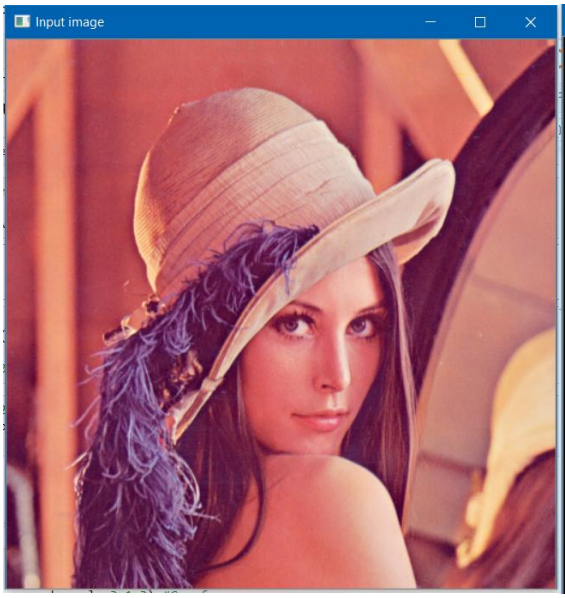
Details = Original – Gaussian , Sharpened image = Original + 2 Details*

Sample Details image

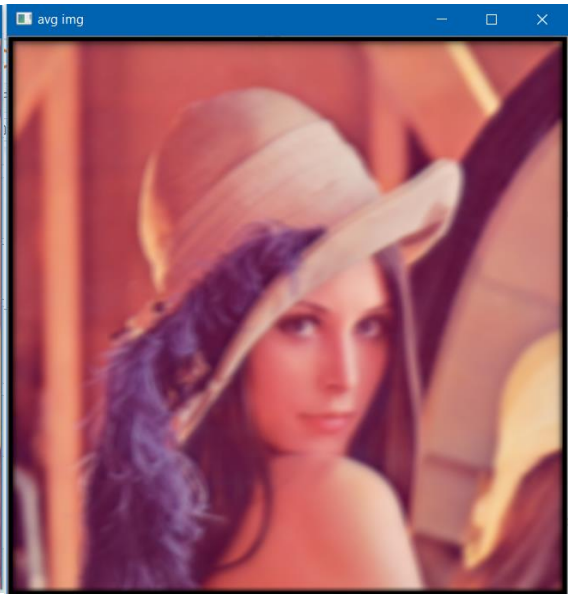


Applying various filter of Kernel Size = 9

Original Image

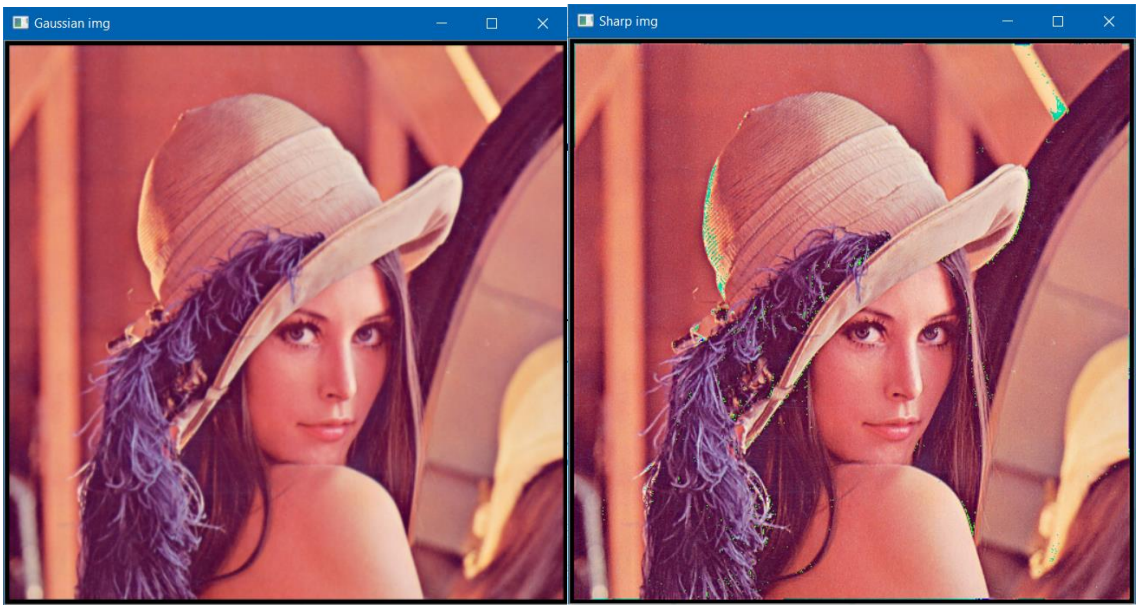


Mean Filter applied Image



Gaussian Filter applied Image

Sharpened image (added details)

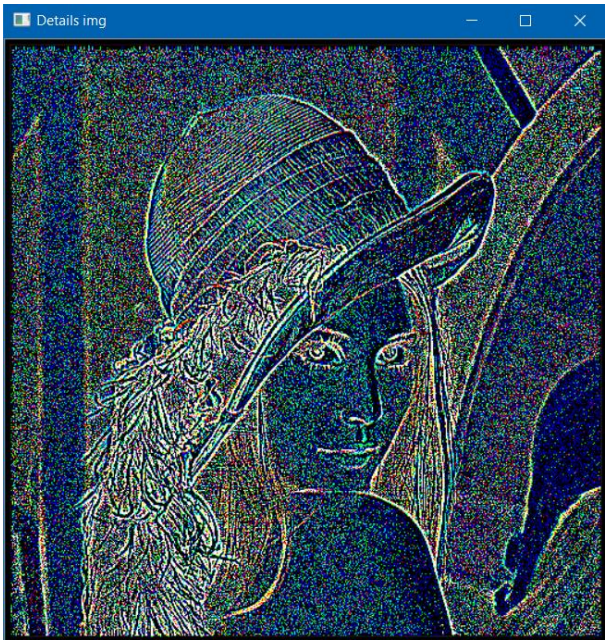


You can see the difference in details in this image more clearly.

For sharpening, I used Gaussian filtered image to extract details. Then I added twice of it back to the original image.

Details = Original – Gaussian , Sharpened image = Original + 2 Details*

Sample Details Image



Observations:

- We have used Mean filters and Gaussian filters of sizes 3, 5 and 9. We then used the Gaussian filter results in this formula mentioned in class for extracting details and sharpening
  Details = Original – Gaussian
  Sharpened image = Original + 2 Details*

- Major observable differences among the filter with different kernel sizes :
  - Mean filter of size 9 does lot more blurring than the mean filter of size 3. This is because of the Kernel size 9 includes lot more pixels spread across different regions to calculate one pixel value. 81 cells are being considered to calculate one cell.

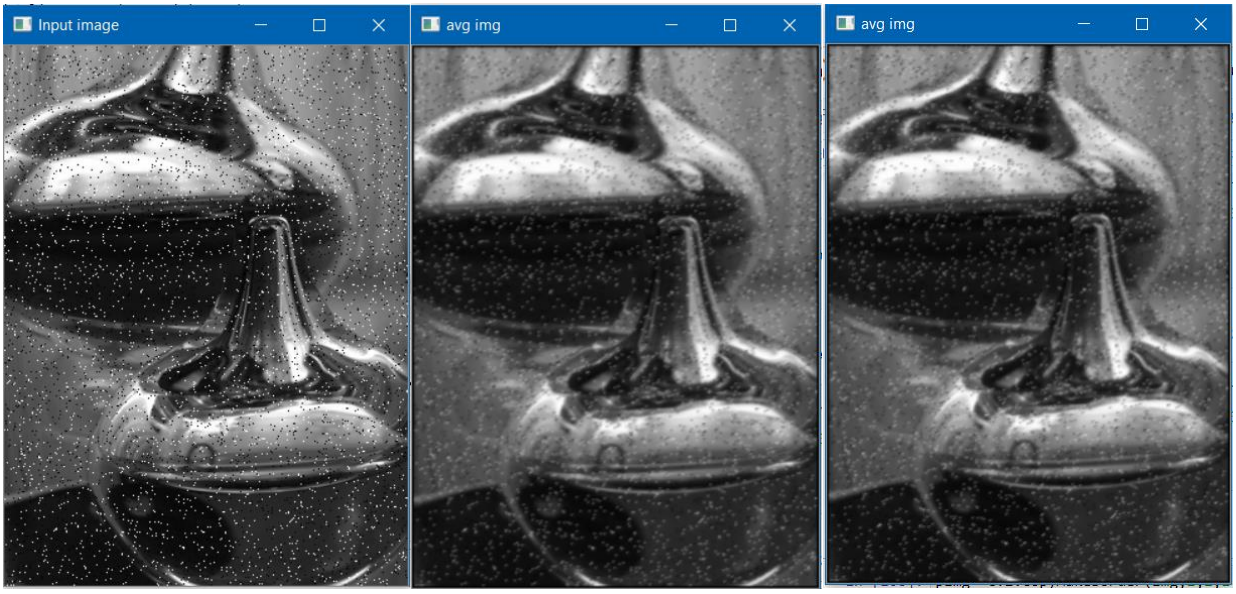
  - Gaussian filter perform better than Mean filter in terms of blurring since the kernel give exponentially less importance to the pixels further away.

  - Some high intensity values in details highlight some colours more than others when sharpening. For example, we can see some green marks in the sharpened image.

Part 2:

Kernel Size 3:

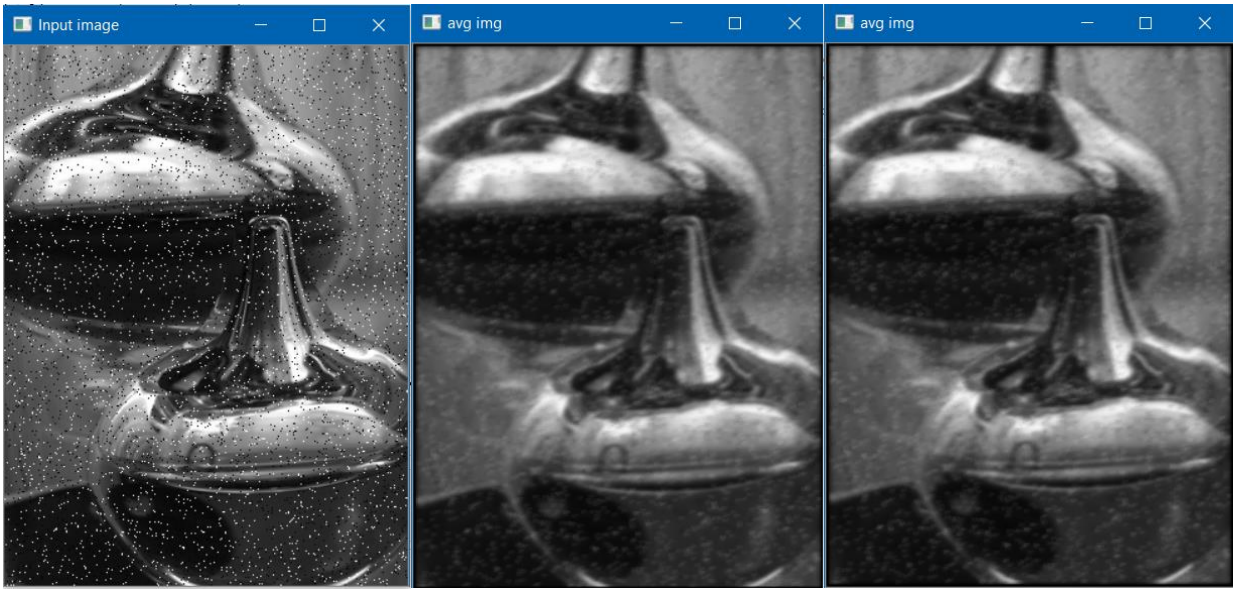
Original input Image **Mean Filter Correlated Image** **Mean Filter Convoluted Image**



Median Filter output Image

Kernel Size = 5:

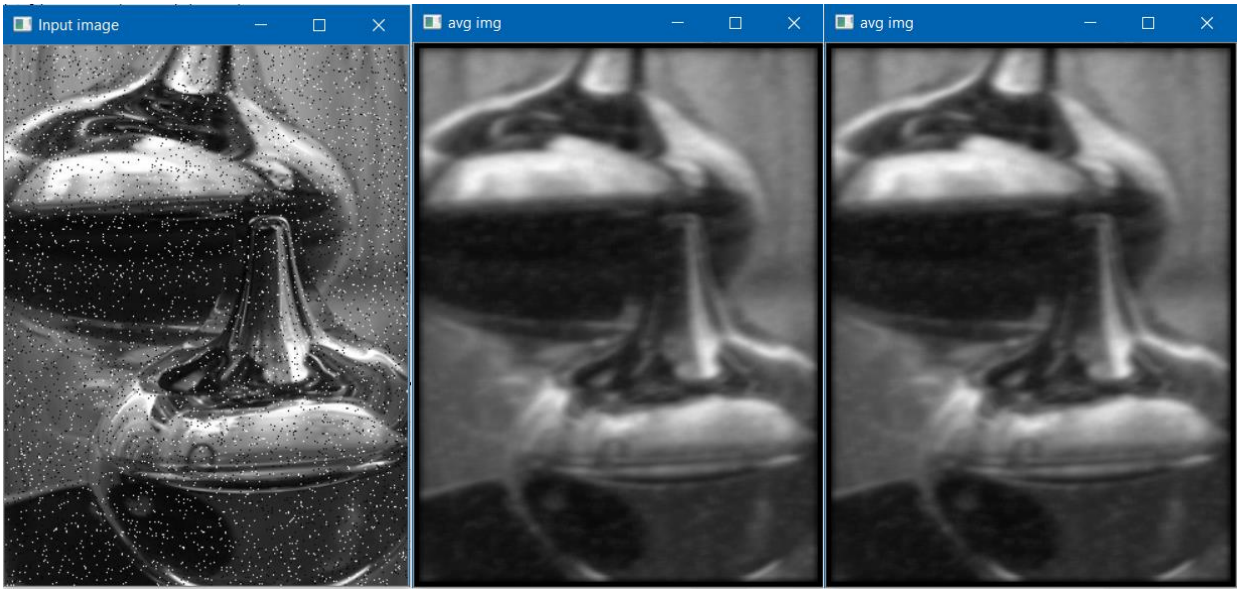
Original input Image **Mean Filter Correlated Image** **Mean Filter Convoluted Image**



Median Filter output Image with kernel size =5

Kernel Size =9

Original input Image **Mean Filter Correlated Image** **Mean Filter Convoluted Image**



Median Filter Kernel size =9

Observations:

- Mean Correlations and Convolution produced same results since they are symmetrically identical. Therefore, during the Convolutions, flips result in the same kernel as of Correlation.
- Mean filter couldn't remove the noise completely. We can see small white dots in the mean images. Noise is less visible in the images with kernel size 9 since the disturbance is nullified a little bit. We can clearly see the noise in the mean image with kernel size 3. Therefore, mean filters are not advised for the removal of noise.
- Median filter are able to remove the noise, as they find a median value in between the sorted array of the pixels. This eliminated the issue of outliers which lie in the ends of array. Therefore, Median filter are preferred to remove noise. They also have sharper edges and retain better information compared to mean filters. Mean filters try to smoothen the edges.
- The kernel filter of size 9 spoils or blurs the image too much compared to other filters. It is because each cell is impacted by 81 cells.