1 Method Explanation

In this assignment, I have applied three image enhancements to enhance the give test images. The enhancement techniques are noise removal, contrast enhancement, and edge enhancement.

1.1 Noise Removal

At first, I used median filter to remove the noise on the image. The median filter could preserve edges while removing noise. And it works well with salt and pepper noise. The median filter takes a 3 by 3 window to run through the entire image entry by entry, and replacing each entry with the median of neighbouring entries.

1.2 Contrast enhancement

In the step, I tried to lower the pixel value of background and increase the intensity of foreground by enhancing the contrast of the image. Since in general, the noise and the background tends to have lower pixel value than the actual signal which is the foreground. I have defined a lower bound threshold and a upper hound threshold for the contrast enhancement. With the thresholds, I could lower the pixel value that is below the lower bound threshold, and increase the pixel value that is above the upper bound threshold. So that, the contrast of the image will be increased.

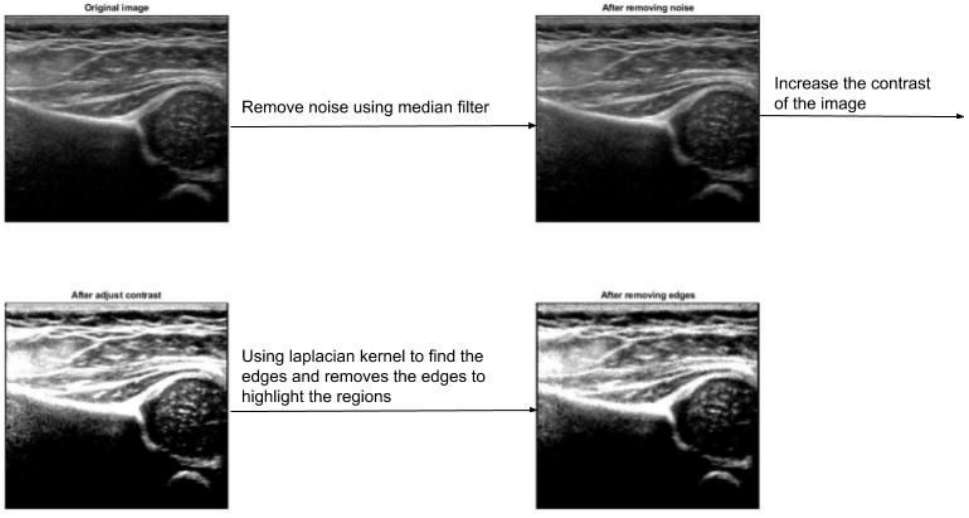
1.3 Edge enhancement

The final step for this image enhancement is edge enhancement. In this part I have used laplacian operator. The laplacian kernel used in this assignment was: [-1 -1 -1;-1 8 -1;-1 -1 -1]. This kernel not only could detect horizontal and vertical edges, but also is able to detection diagonal edges. During the process, the laplacian kernel was used as a convolution kernel that applied on the image shown in the following equation: J = I * K, where I is the original image, J is the filtered image and K is the laplacian kernel.

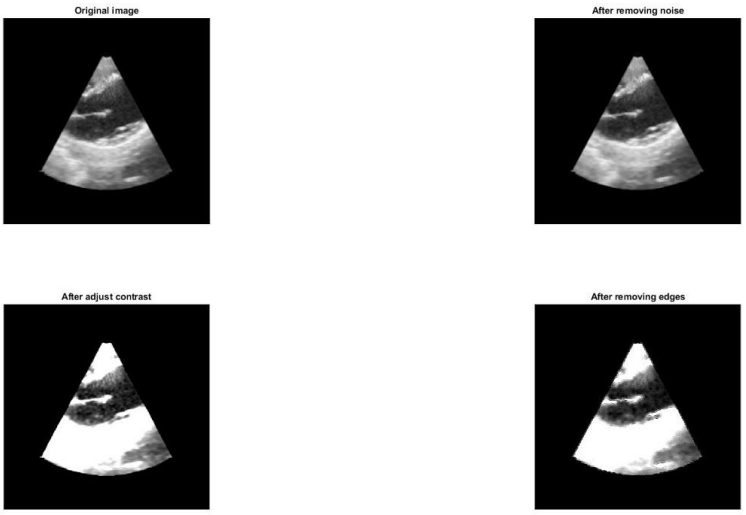
After applying edge enhancement, the edges of all major objects in the original images are filtered out. So that I could subtract the edges from the original images to enhance the object itself. Then I have compared the result visually, by SNR and by contrast to show the effectiveness of my algorithm.

2 Result

The following image is dataset1_img_hip.jpg. The region of interest is the bone, which is shown in the mask.



This image shows the result for dataset2_img_heart.jpg. The region of interest is the valve.



The following table shows the SNR and contrast for both datasets.

SNR and Contrast comparison				
Steps	SNR-dataset 1	CONTRAST-dataset 1	SNR-dataset 2	CONTRAST-dataset 2
Original Image	22.555377	4.115352	11.762429	1.412842
After removing noise	23.106560	4.134800	11.742563	1.407833
After contrast enhancement	43.446171	6.647346	13.494462	2.341393
After removing edges	53.853553	6.342951	14.229601	2.224937

3. Conclusion

The techniques used in the assignment are median filter for noise removal, contrast enhancement using predefined threshold, and edge enhancement using laplacian kernel for convolution. The median filter is very effective at removing ‘salt and pepper’ type noise. But one drawback of the median filter is that it usually give the image a blurring effect. The contrast enhancement using predefined helps a lot in increase the intensity of the interested region. However, the threshold need to be adjusted for each image. The laplacian operator for edge enhancement requires less computation time than other edge enhancement techniques since it only has one kernel. However, it is sensitive to noise. So, in order to get a good result, we need to remove noises on image before applying the laplacian operator.

For the result, comparing to the original images, the regions of interest are highlighted in the enhanced images. Also, SNR and contrast also were increased on the

enhanced images. Therefore, we can say that this algorithm is effective for image enhancement.

There is still improvement could be done to enhance the image. For one example, the original image contain to much noise, and the noise removal step could not clear all noise. Therefore, if we could find better way to filter the noise, then the image enhancement could be a lot better.