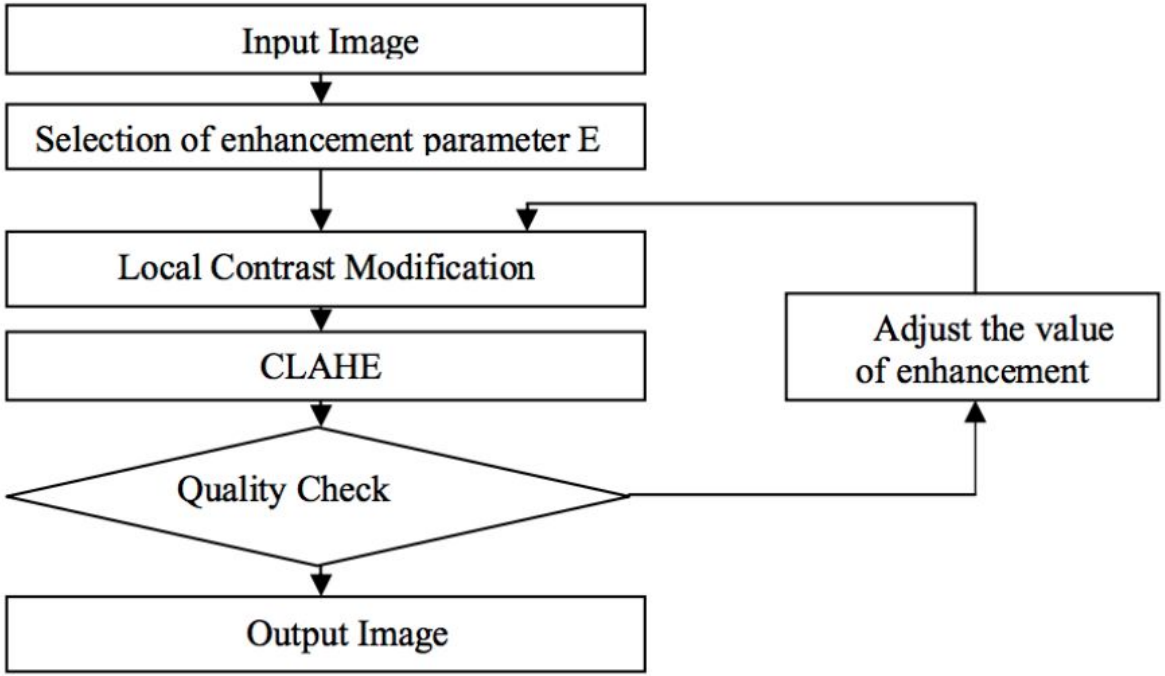
Contrast Limited Adaptive Histogram Equalization for detection of masses and micro calcification of mammogram images

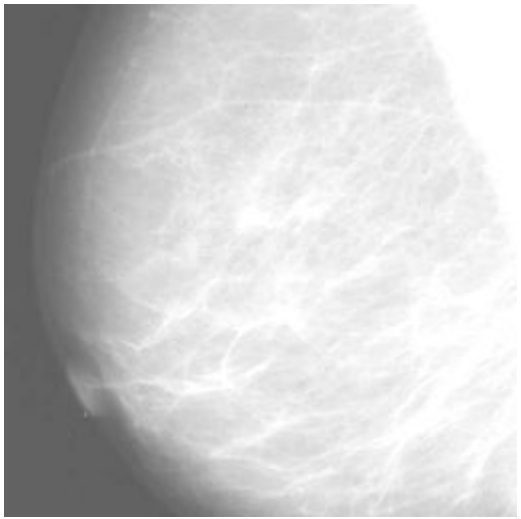
By
Shashank Shantam
ECE-C, 54
140907716

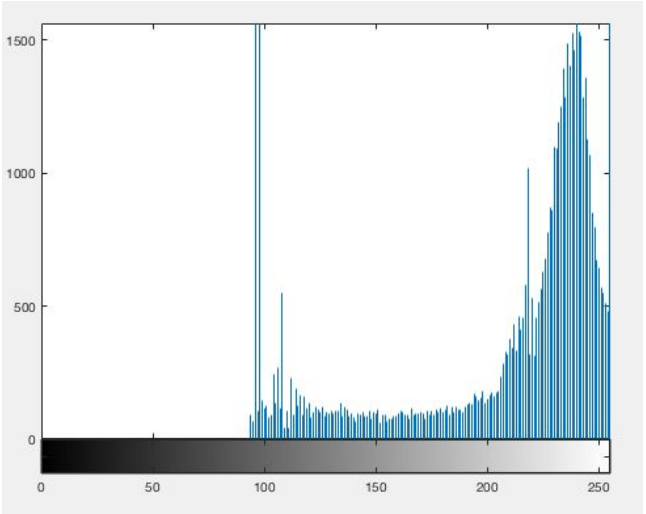
Proposed Method



Results

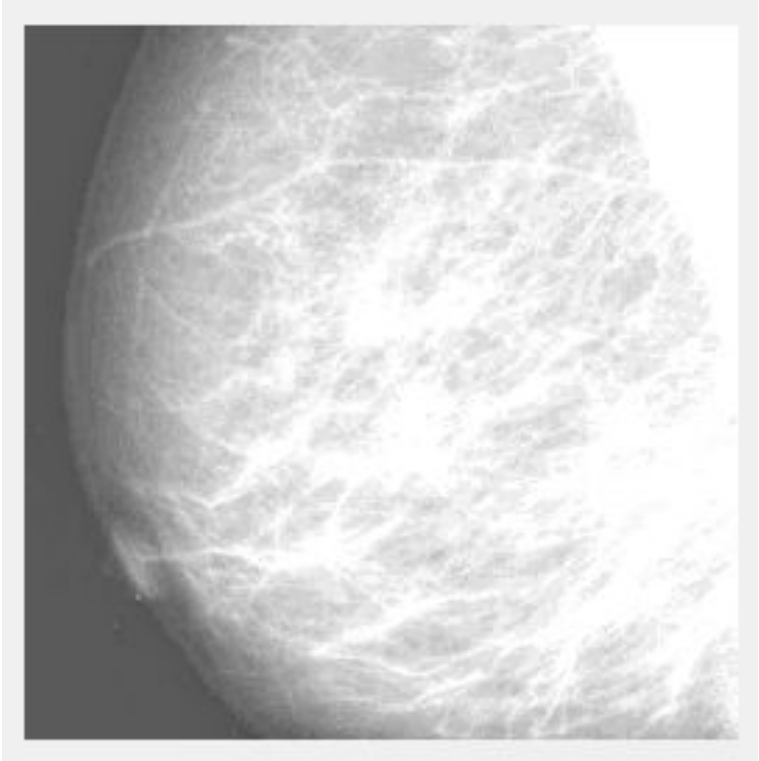
Mammogram images are given as the input to the algorithm. One of the test images is shown below along with its histogram

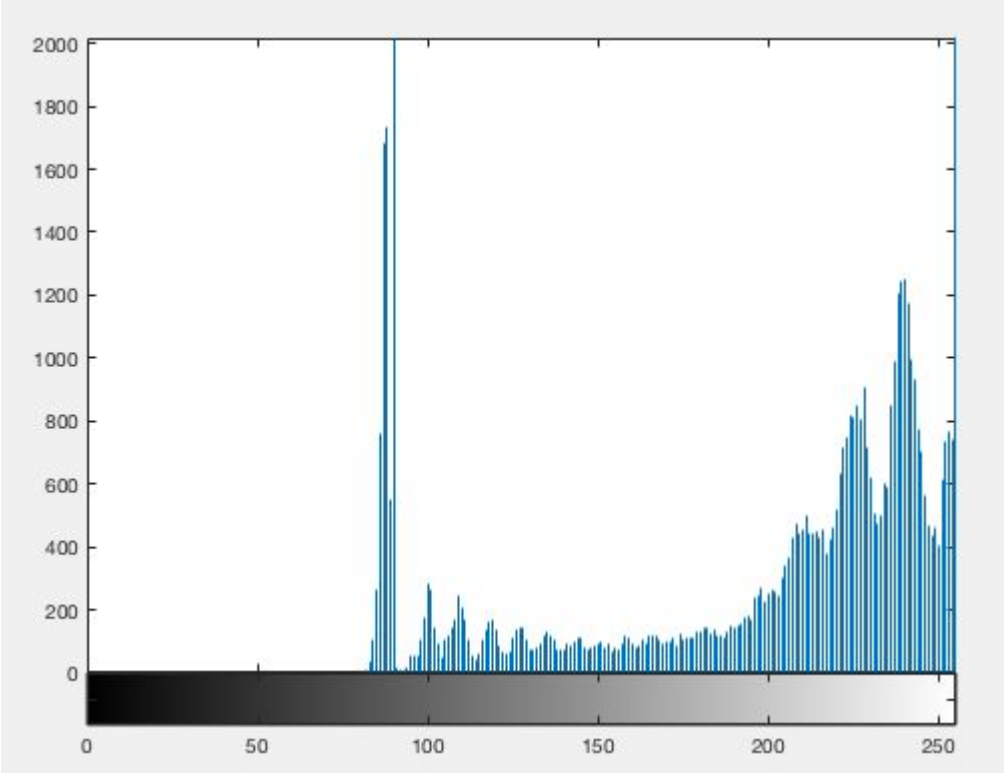




Results

This input image is then passed as an input to the localcontrast function of MATLAB to perform Local Contrast Modification (LCM). LCM is used to capture both global and local information of the mammogram image. The parameters edgeThreshold and amount is used to preserve strong edges and specify smoothing/enhancement. The output of LCM method is shown below along with its histogram. Desired results can be obtained by tweaking with the parameters. For this case, edgeThreshold of 0.2 and amount of 0.5 is chosen.

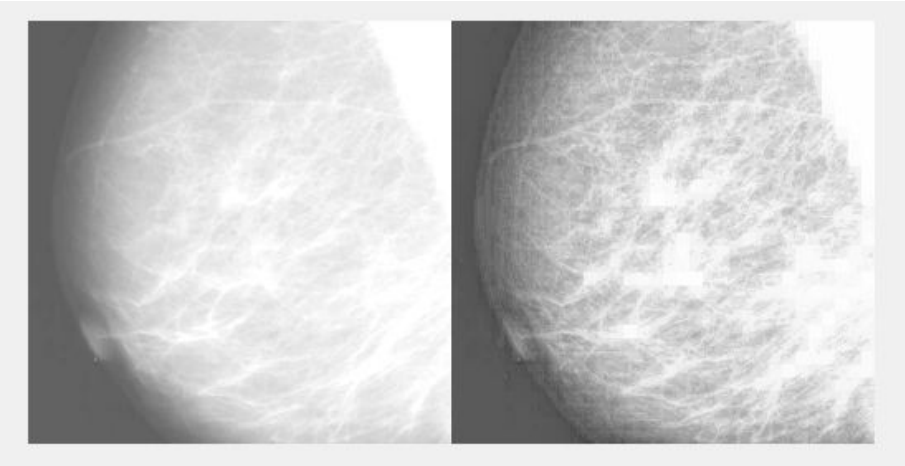


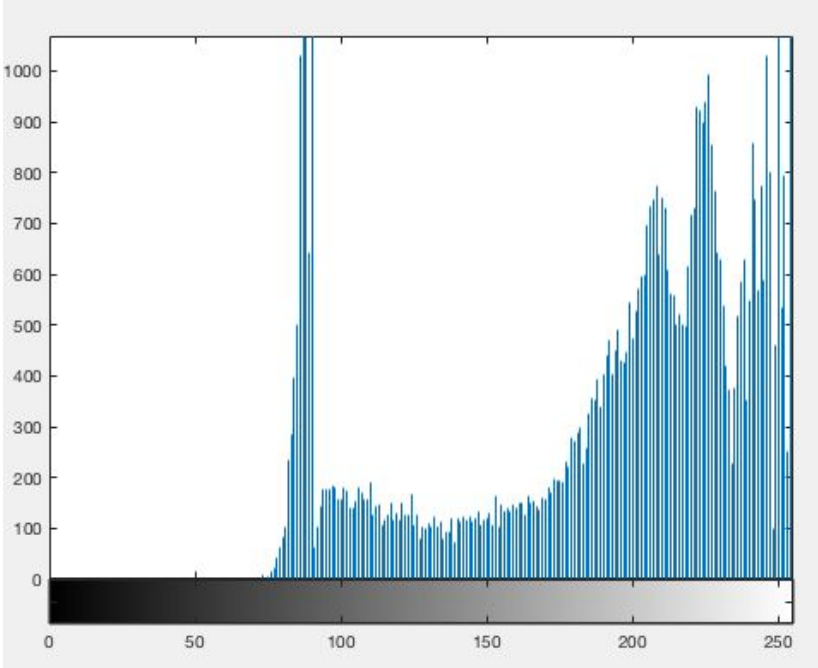


Output of LCM

Results

Finally, the output of the LCM modification is then passed as the input to perform Contrast Limited Adaptive Histogram Equalization (CLAHE). For this case, a block of 8x8 is chosen. This block processing results in block artifacts occurring in the image. These artifacts can be reduced by using bigger blocks, or overlapping blocks. But this reduces the localization that is a crucial feature of CLAHE. Thus there is a tradeoff which and decisions on the parameter must be take according to the application. The output of CLAHE is shown below with its histogram.





Output of CLAHE

Observations

1. As can be seen from the output image, contrast enhancement has been performed. This can be verified by comparing the histogram of the input and output images. The pixels have been redistributed so that a greater dynamic range of pixel intensities is obtained.
2. However, as can be observed from the output image block artifacts appear in the images due to block processing. This can be reduced however by using larger blocks, say 16x16, but larger blocks would reduce the localisation provided by CLAHE. Therefore, based on the application and requirements, appropriate block sizes can be chosen.

Comparison Metric

An image is said to be enhanced if it allows the viewer to better perceive the desirable information in the image. The performance measure used here is Peak Signal to Noise Ratio (PSNR). The PSNR value of an image G with respect to the original image F, both of size M×N pixels, is calculated as shown below

$$M_s = \sum_{m,n} [F(m,n) - G(m,n)]^2$$

$$PSNR = 10 * \log 10 \frac{255^2}{M_s}$$

Where Ms is the mean Squared Error.

To evaluate the performance of our proposed LCM-CLAHE method and compare it with traditional histogram equalization, Local Contrast Modification and CLAHE output, we compare their respective PSNR values.

Comparison of PSNR

Proposed Algorithm	PSNR
Histogram Equalization	9.6610
Adaptive Histogram Equalization (CLAHE)	12.0595
Local Contrast Modification (LCM)	31.7528
Proposed LCM-CLAHE	23.2240

From experimental result, it is clear that LCM-CLAHE provides an optimal contrast enhancement for the image (PSNR=23.2240) without losing the finer information of original image whereas for CLAHE (PSNR=12.0595), HE (PSNR=9.6610) is not enhanced properly and LCM (PSNR=31.7528) shows over enhancement.

Conclusion

A new approach for image enhancement using Modified CLAHE based on local contrast enhancement has been presented in this paper. The proposed method provides a better contrast enhancement and information preservation of input mammogram image. The experimental results of LCM-CLAHE show that this method is more effective without compromising contrast as well as original information and hence is widely used in subjective and objective medical evaluation.

While the proposed algorithm has only been tested for mammogram images, tweaks and adjustments can be made to for amending the proposed method for other types of medical images.

ThankYou