

Study and Comparison of Various Filters and Their Effect on Ultrasound Image Segmentation

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Abstract: *Ultrasound is widely used in medical applications. However, the problem in ultrasound images is they contain many speckles, and this make a sonographer hard to interpret the ultrasound image. During transmit & storage of Ultrasound images various other types of noise also get added up interfering with image analysis & interpretation. Our idea was to solve this problem by carrying out the pre-processing of images before proceed with further image processing techniques. In our work various image processing filters were used to remove the speckles, impulse & Gaussian noise so that the area of the region needed is clearer. The segmentation performed after pre-processing (identifying & removing the noise & enhancement) can help sonographer to analyze the ultrasound images qualitatively and quantitatively. In our work Linear and nonlinear filters were used for image pre-processing and their performance is compared with respect to the effect of segmentation of the ultrasound images. Few novel filters from both the categories were identified, implemented and feasible modifications were later incorporated. Then the segmentation process was carried out with the promising results were presented in the form of qualitative and quantitative dimensions in the final stage of our work.*

Keywords: Ultrasound images, Filters, Thresholding process, Morphological process, Segmentation

1. Introduction

Ultrasound is an oscillating sound pressure wave with a frequency greater than the upper limit of the human hearing range. Ultrasound is used in many different fields. Ultrasonic devices are used to detect objects and measure distances. Ultrasonic imaging (sonography) is used in both veterinary medicine and human medicine. In the non-destructive testing of products and structures, ultrasound is used to detect invisible flaws. Industrially, ultrasound is used for cleaning and for mixing, and to accelerate chemical processes.

Ultrasonic is the application of ultrasound. Ultrasound can be used for medical imaging, detection, measurement and cleaning. At higher power levels, ultrasonic is useful for changing the chemical properties of substances.

Diagnostic sonography is an ultrasound-based diagnostic imaging technique used for visualizing subcutaneous body structures including tendons, muscles, joints, vessels and internal organs for possible pathology or lesions. Obstetric sonography is commonly used during pregnancy.

2. Details of the Work Carried Out

2.1. Methodology

A method is proposed to analyze the ultrasound image. In this work, different types of filters are used to see the difference in the quality of image we get using various types of filters.

The process is as follows:

1. Reading the ultrasound image from the data set.
2. Filtering the ultrasound image using different filters such as median filter, wiener filter and unsharp filter, bilateral filter.

3. After filtering process, the images undergo the thresholding method.
4. After thresholding process, the reprocessing of the image using morphological technique takes place; here the open-close method of morphology is used.
5. And the next process that will be carried out is segmenting the images; here we have used two methods for segmentation.
6. Marker controlled watershed segmentation
7. Texture segmentation using texture filter
8. The different images got after segmentation process are taken.
9. The image got after segmentation which has undergone through filtering, thresholding process, morphological process and segmentation process and the image undergone through threshold process, morphological process and segmentation process is compared i.e. without undergoing the filtering.
10. The images that are got as stated above are compared.
11. The comparison is done qualitatively by examining the different output images that we get and qualitatively by calculating MSE and PSNR.

2.2 Algorithm

- Read an image from the data set
- Add noise to image (if the image is already noisy then go to next step)
- The different filters like Median, Unsharp, Wiener, bilateral filters are used to remove the noise and speckles
- Thresholding of filtered image is carried out
- Perform Morphological process i.e. open-close method
- Segmentation of the image is carried out using two methods
 - a. Marker controlled watershed segmentation
 - b. Texture segmentation using texture filter
- Compare the images as stated in the methodology

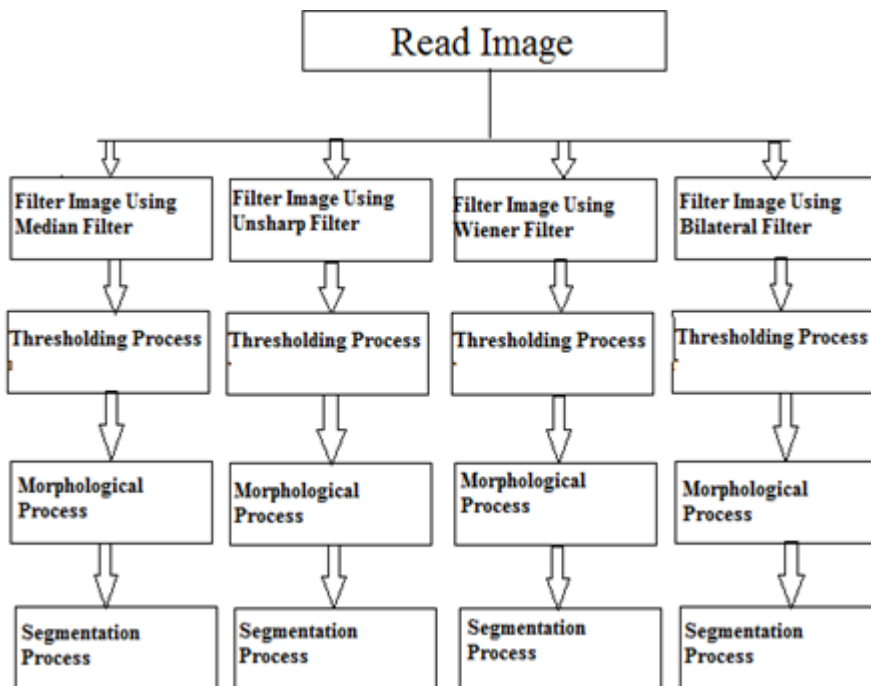
3. Results and Discussion

- A comparison of the images, shows that the images were blurred after applying the Median and Wiener filtering techniques. The blurring in Median filtering reduces the speckle noise while keeping the image edges. However, the resulting blurring in wiener filtering is different from Median filtering.
- In the median filtering, the speckle noise reduced but the image edges were maintained. By using Wiener filtering, the speckle is reduced but the image edges are intact. Also, the images are sharper compared with Median filtering. Although speckle is reduced well and structures

are enhanced using Wiener filter, however, some details are lost and some are over-enhanced.

- But viewing the results of unsharp and bilateral filters we can notice that most of the information from the original image is lost, so using these filters in the pre-processing is not suitable
- But the results provided by median and wiener filter are able to remove noise, reduce speckles, preserve edges and can be used in real time application.

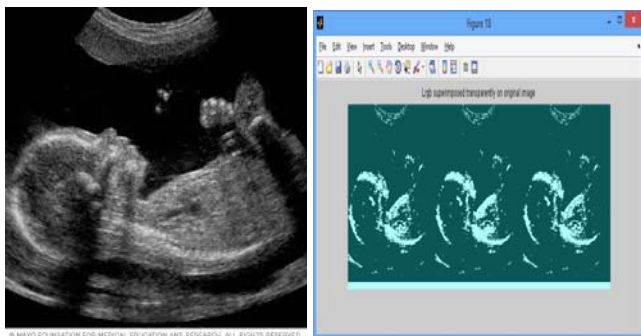
4. Flow Diagram



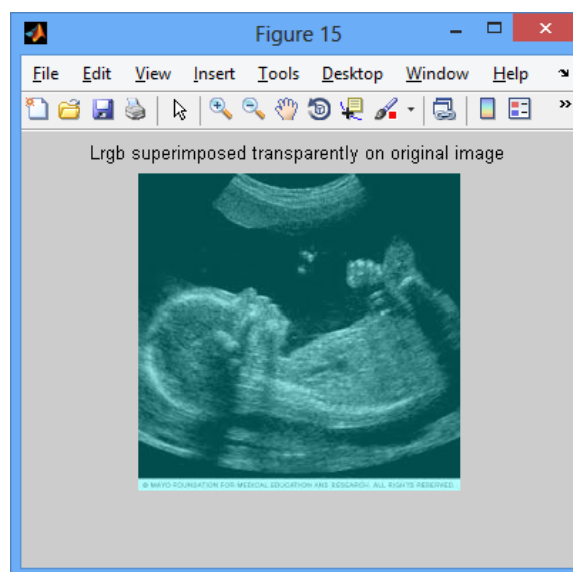
5. Output

5.1 Output Images

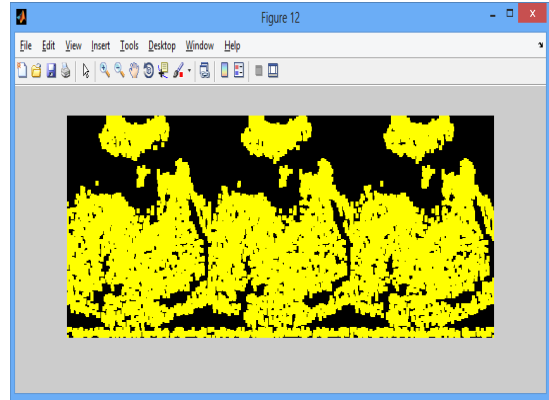
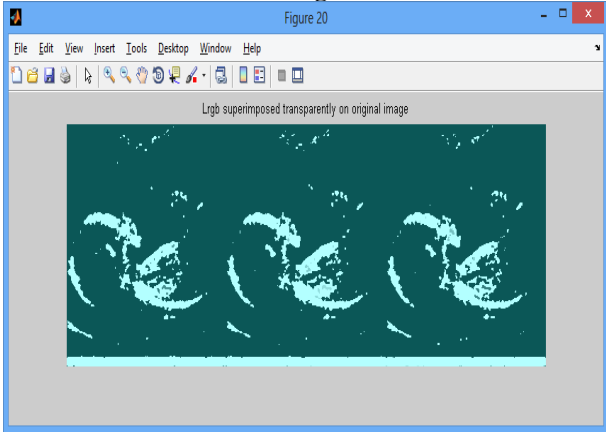
5.1.1 Original Ultrasound Image Output Image without using Filters



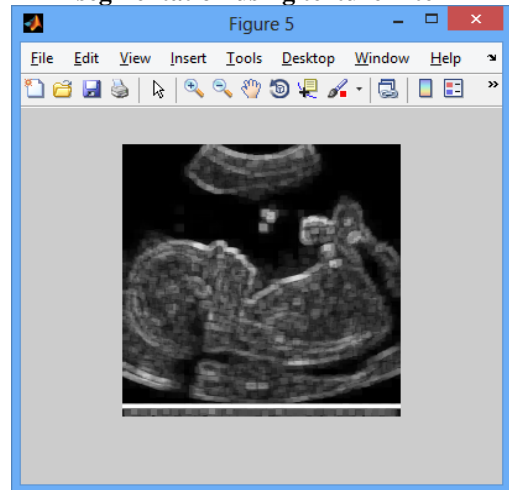
a. Output of US image only undergone through marker controlled watershed segmentation



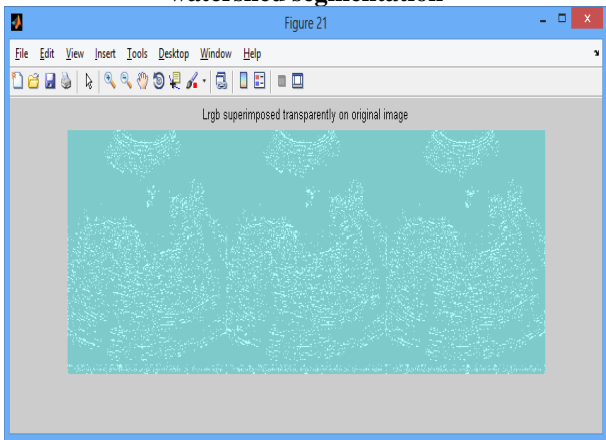
Output of Median Filter using marker controlled watershed segmentation



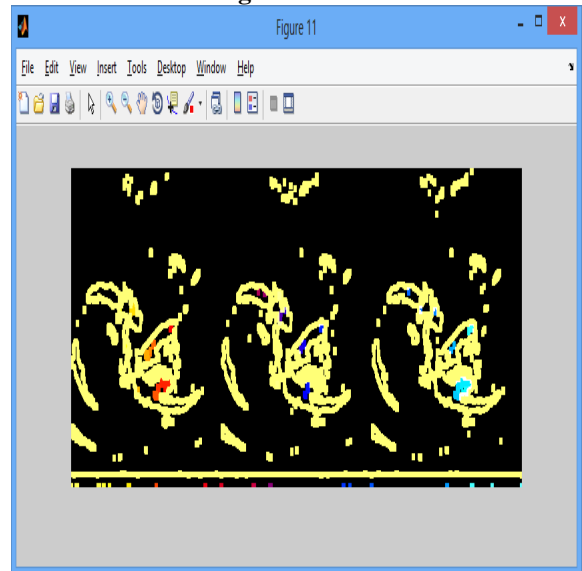
b. Output of US image only undergone through texture segmentation using texture filter



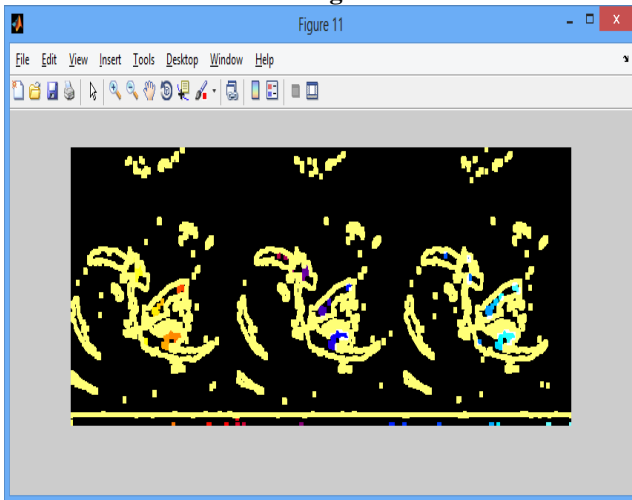
Output of Unsharp Filter using marker controlled watershed segmentation



Output of Median Filter using texture segmentation using texture filter

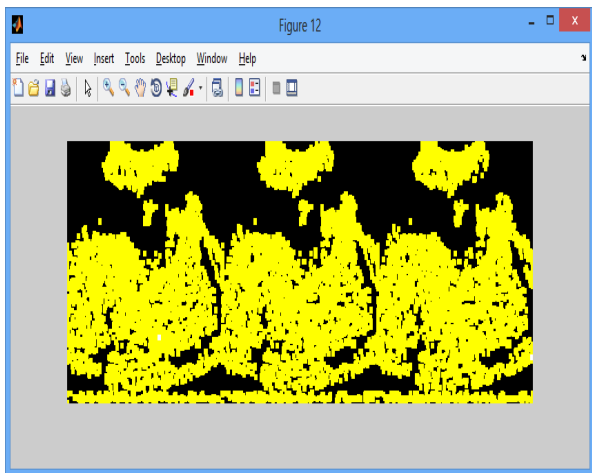


Output of Weiner Filter using marker controlled watershed segmentation

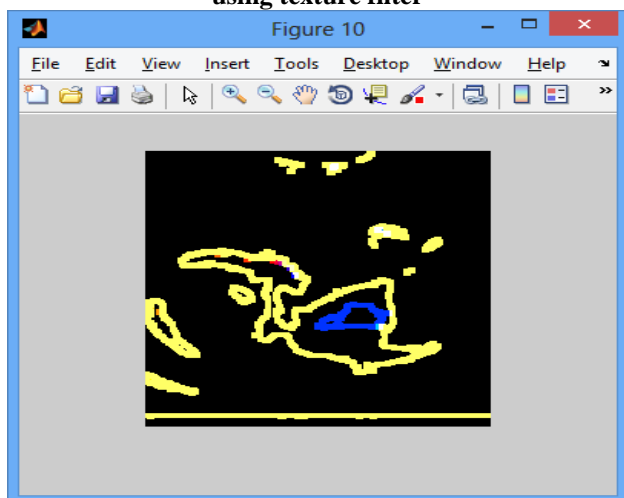


Output of Bilateral Filter using marker controlled watershed segmentation

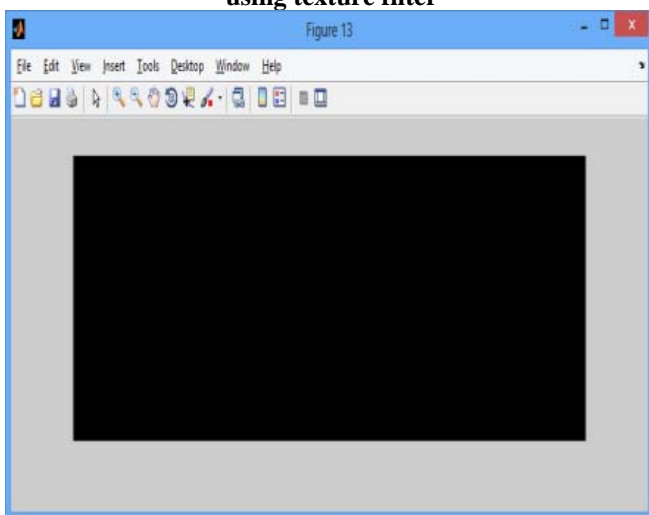
Output of Unsharp Filter using texture segmentation using texture filter



Output of Wiener Filter using texture segmentation using texture filter



Output of Bilateral Filter using texture segmentation using texture filter



6. Conclusion

- Viewing the results of unsharp and bilateral filters we can notice that most of the information from the original image is lost, so using these filters in the pre-processing is not suitable

- The results provided by median and wiener filter are able to remove noise, reduce speckles, preserve edges and can be used in real time application.
- Therefore there is no ideal filter, It is empirically known that a certain filter works excellently for a certain type of original image or degradation while it may not be suitable for other images. It means there is no universally optimal filter. Therefore, the choice of the right filter is important as it will determine the final result of the images and the choice of filter depends on our application and we need to consider the accuracy, real time applications, feasible modifications, computational speed, to improve the SNR we need to take more number of iterations.

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