Sharpening Enhancement of Ultrasound Images using Intelligent Water Drops

Himanshu Sharma 1 and Dr. V. K. Banga 2
1M. Tech. Scholar, Deptt. of ECE, ACET Amritsar, Punjab, INDIA. (Email: himanshu_744@yahoo.com)
2Professor, Deptt. of ECE, ACET Amritsar, Punjab, INDIA. (Email: vijaykumar.banga@gmail.com)

Abstract— In Medical ultrasonography the image quality varies greatly between patients and organs. The furry regions of ultrasound images are to be enhanced for good quality visual perception. This paper proposes a Intelligent Water Drops (IWD) based sharpening technique (ST) for contrast enhancement ultrasound (US) images. The proposed technique IWD is operated on the multiscale, multidirectional IWD decomposition of the underlying US image. The results are compared with contourlet transform(CT) with the proposed IWD. The parameters like enhancement measure, structural, structural similarity and Peak signal to noise ratio evaluate the improved performances of the proposed technique.

Keywords— Water drops, Ultrasonography, Intelligent imaging, image enhancement.

I. INTRODUCTION

An ultrasound (US) is a noninvasive medical test that helps physicians to diagnose and treat medical conditions. Although there are many advantages of using ultrasound as an imaging modality, they are hampered by contrast effect[1,2] either in error or as an effect of image acquisition. Medical ultrasonography is used in a wide range of areas of patient diagnosis, where maybe obstetrics (woman and unborn child during pregnancy) and cardiology (heart and blood vessels) are the most well known to the general public. The image quality varies greatly between patients and organs. Improved image quality enhances the diagnosis accuracy and has the potential to open up for increased use of ultrasound imaging e.g. in breast and prostate cancer diagnosis and screening.

The medical ultrasound imaging modality suits especially well for imaging of soft tissue and muscles. It owes its popularity amongst others to its non-invasive nature, and that the equipment is inexpensive and portable compared to e.g. nuclear magnetic resonance (NMR) and X-ray computed tomography (CT). Furthermore, it has no known medical side effects, and the images are produced in real-time, therefore shortening the delay between patient examination and diagnosis. Ultrasound waves propagating in human tissue are longitudinal compression waves traveling at about 1540m/s. The temporal wave frequency utilized for most medical imaging is within the approximate interval from 1 to 15MHz, corresponding to wavelengths between 1.5 and 0.1mm.

The small contrast between foreground and background, human vision strains to achieve better focus and weak identification of sharp edges are felt as lack of details. Sharpening is an important image enhancement method to increase the contrast between bright and dark region to bring out boundary features [3,4]. In particular more research work on US image sharpening has been published and became a research focus[5,6].

The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. It accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis. The enhancement doesn’t increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily.

Besides the common enhancement algorithms, wavelet based enhancement are also found in the literature[7,8]. Though wavelets are very useful in representing the high frequency components in the form of
edges, they fail to capture anisotropic features. Contourlet transform provides anisotropic features with more directions [9,10] but more favourable results in parameters can be brought up by IWD. Therefore this paper proposes a IWD based sharpening method that can be able to control the noise while enhancing.

II. INTELLIGENT WATER DROPS

Intelligent water drops algorithm or IWD algorithm is swarm based nature inspired optimization algorithm. This algorithm contains few essential elements of natural water drops and actions and reactions that occurs between the river’s beds and the water drops that flow within. The IWD algorithm may fall into the category of swarm intelligence and metaheuristic. Intrinsically, the IWD algorithm can be used for combinational optimization. However, it may be adapted for continuous optimization too. The IWD was first introduced for the travelling salesman problem in 2007. Since then, multitude of researchers has focused on improving the algorithm for different problems.

Almost every IWD algorithm is composed of two parts: a graph that plays the role of distributed memory on which soils of different edges are preserved, and the moving part of the IWD algorithm, which is a few number of intelligent water drops. These Intelligent Water Drops (IWDs) both compete and cooperate to find better solutions and by changing soils of the graph, the paths to better solutions become more reachable. It is mentioned that the IWD-based algorithms need at least two IWDs to work.

IWD Flow Chart

III. EXPERIMENTAL RESULTS AND PERFORMANCE COMPARISON

The proposed technique is implemented in MATLAB by developing GUI and it works like as shown in figures.

Fig 1 first shows the Sample is selected as an input input image.
IV. CONCLUSION

This paper presented a sharpening technique (ST) for ultrasound image enhancement for a good quality of visual perception. The proposed ST overcomes the problem of the classical ST that improves the noise while enhancing. The performances are evaluated using structural similarity (SSSIM), peak signal to noise ratio (PSNR) and enhancement measure (EME) parameters. The subjective and objective results illustrated that the proposed ST produces enhanced results in good quality with more similarity with the original image.

V. REFERENCES