Designing of ESF filter for underwater image enhancement

[1]Gaurav Mangla,[2]Sukhjinder Singh

1Student,GKU,Talwandi Sabo, Deptt of ECE.

[2] Asstt. Prof. At GKU,Talwandi Sabo, Deptt of ECE.

Abstract:
Underwater image enhancement techniques provide a way to improve the object identification in underwater environment. Underwater sea images needs to be pre-processed due to quality of sea water images. When we capture such images, quality of images degrade due to many factors like ripples in water, lack of availability of light, organic matter dissolved in water etc and also such images are captured from a very small distance , so the images must be pre processed before applying any kind of operation on these images. To improve the quality of image the image is passed through filters. Various kind of filters upto a precision are available till now. In this paper unsharp masking technique has been proposed to sharpen such images. Proposed technique has been compared with existing filter in terms of psnr and mse.

Keywords: Image Pre-processing, Peak signal to noise ration, Mean square error, Unsharp masking filter.

1. Introduction

Underwater image enhancement techniques are used to improve the clarity of images. Underwater sea images need to be pre-processed due to many factors. Underwater images are however disturbed due to ripples in water, colour diminishing, limited range of light and so many other factors. Many techniques are available upto a precision level till now. Anistropic filter is used for the smoothening of images. But computation time of this filter is very high as it is iterative in nature.

The remaining of the paper is organized as follows: Section II includes the previous researches done in the field of underwater image pre-processing. Section-III describes the complete methodology of proposed algorithm. In section-IV results and comparison of proposed methodology with existing filters has been described. Finally conclusion of proposed approach has been given in section-V.

2. Literature survey

Recently, many researchers have developed pre processing techniques for underwater images using image enhancement methods. Prabhakar C.J. et. al. [1] studied an image based preprocessing technique to enhance the quality of the underwater images. The technique comprises a combination of four filters such as homomorphic filtering, wavelet denoising, bilateral filter and contrast equalization. These filters are applied sequentially on degraded underwater images. The literature survey reveals that image based preprocessing algorithms uses standard filter techniques with various combinations. For smoothing the image, the image based preprocessing algorithms uses the anisotropic filter. The main drawback of the anisotropic filter is that iterative in nature and computation time is high compared to bilateral filter. In addition to other three filters, the author had employed a bilateral filter for smoothing the image. The technique using quantitative based criteria such as a gradient magnitude histogram and Peak Signal to Noise Ratio (PSNR). Further, the results are qualitatively evaluated based on edge detection results.

G.Padmavathi et. al. [2] studied that the under water images suffer from quality degradation due to transmission of limited range of light, low contrast and blurred image due to quality of light and diminishing color. When an underwater image is captured, pre-processing is necessarily done to correct and adjust the image for further study and processing. Different filtering techniques are available in the literature for pre-processing of underwater images. The filters used normally improve the image quality, suppress the noise, preserves the edges in an image, enhance and smoothen the image. Therefore three famous filters namely, homomorphic filter, anisotropic diffusion and wavelet denoising by average filter used for under water image pre-processing. The speckle reduction by anisotropic filter improves the image quality, suppressed the noise, preserves the edges in an image, enhance and smoothen the image .The mean square error value which must be low for an image and peak signal to noise ratio which must be high in an image. Isabelle Quidu et. al. [3] proposed that underwater images suffer from limited range, non uniform lighting, low contrast, diminished colors, and important blur. Moreover many parameters can modify the optical properties of the water and underwater images show large temporal and spatial variations. So, it is necessary to pre-process those images before using usual image processing methods. The various filter composed homomorphic filtering to reduce illumination problems and to enhance the contrast, wavelet denoising and anisotropic filtering to cancel out the noise and enhance edges, contrast adjustment

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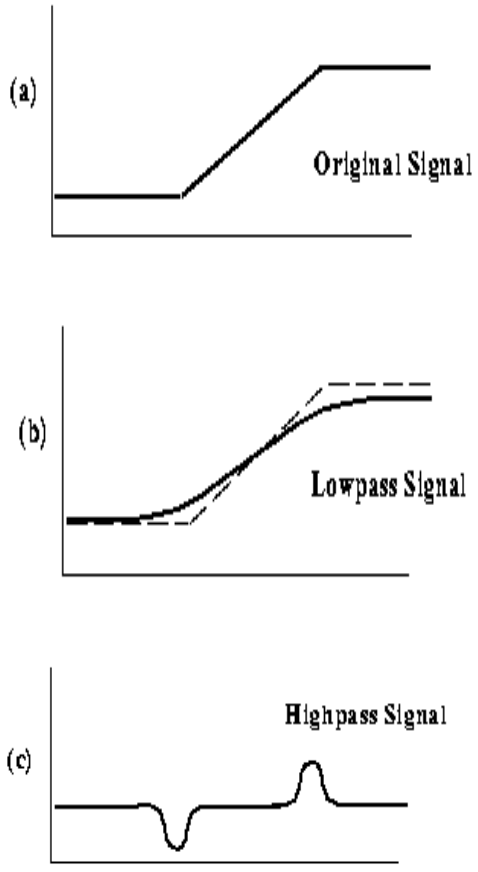
and color compensation to suppress the predominant color.

3. Proposed methodology

Proposed approach allows to enhance the quality of underwater sea images preserving edges in images. A filter has been designed to sharpen the edges of image. The presented approach work for filtering images with different file formats e.g. BMP, JPG, GIF, TIFF etc. Proposed system has been compared with existing filters in terms of image visual quality, MSE and PSNR. Proposed system has been designed in MATLAB. In proposed approach unsharp operator has been used for image sharpening. Sharpness is actually contrasted between different colours. Sharpening images increases the contrast along the edges where different colours meet. Proposed methodology works on the following approach. In methodology shown below in figure (a) an original signal has been shown. This is passed through a low pass filter to generate a low pass signal figure (b). When original signal is subtracted from low pass signal it will yield a high pass signal. When this highpassed signal is added to original signal it will produce sharpened edges.



Proposed methodology works in three steps. Steps of designing filter have been given below:

1. Add some noise in image to produce blurred version of image.
2. Create a low pass filter to produce smoothened version of image.
3. Pass the image through low pass filter and allow passing the low frequencies then threshold frequency.
4. Subtract the smoothened version of image from blurred image to produce a description of edges of image.

4. Results and discussions

Proposed methodology has been tested on four different sea water images. Test images have been shown below:

Figure 1: Set of test images

The images shown above are in different image formats. Proposed filter has been compared with homomorphic filter and bilateral filter. Results of various images have been shown below.

Figure shown below gives the result for image sea.jpg after applying proposed filter, Homomorphic filter and bilateral filter.

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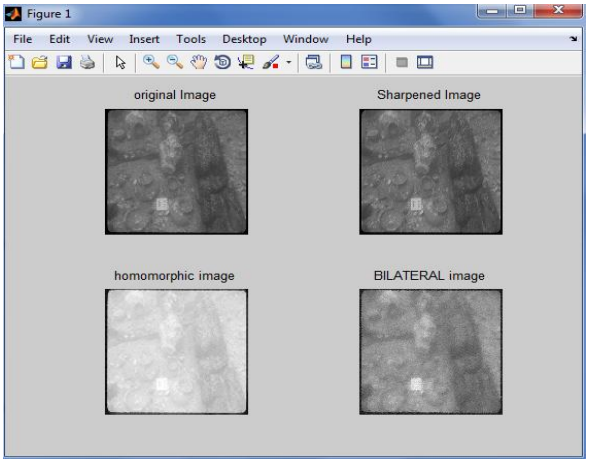

Figure: Result for image sea.jpg

Figure gives the comparsion of various filters on image fish.jpg

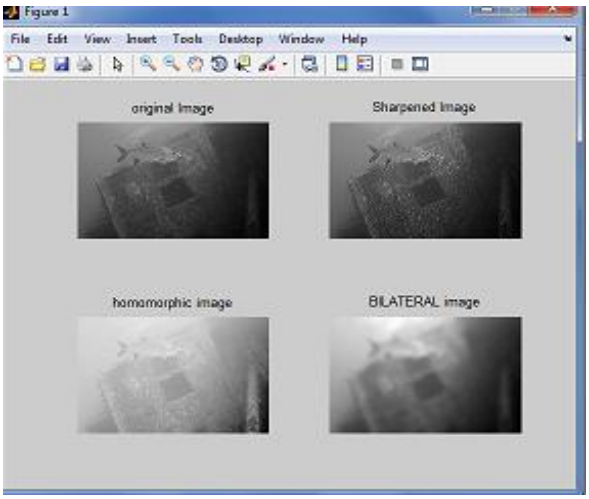

Figure: Result of various filters for Fish.jpg

The image shown below shows the results for image titanic.png

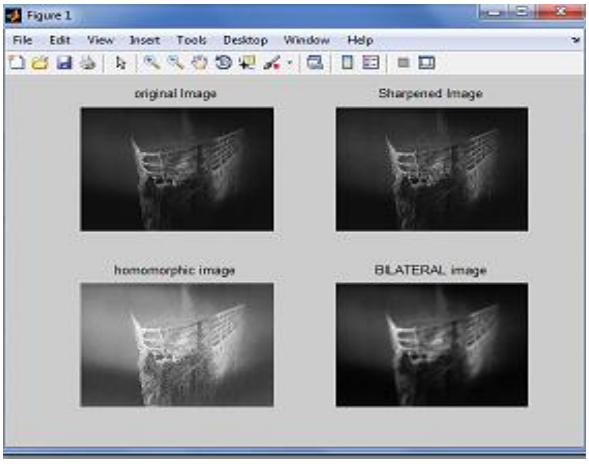

Figure: Result of various filter for Titanic.png

The figure given below shows the results of various filter for image test3.jpg

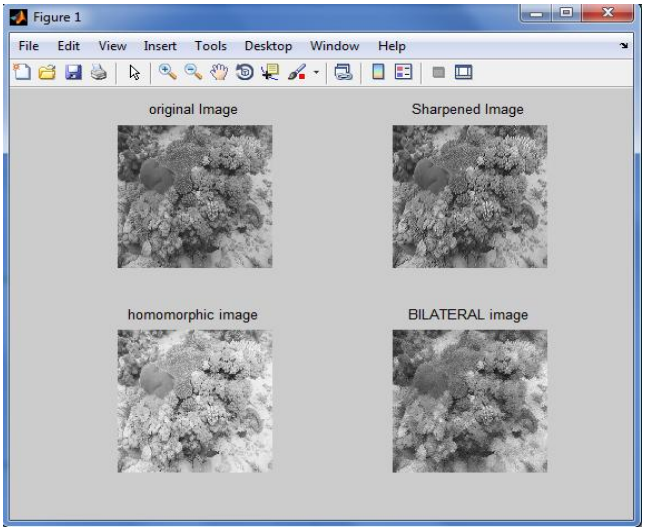

Figure: Resuts for various filters for test3.jpg

Table shown below gives the comparison of various filters on set of original images for the PSNR value and MSE to show the effectiveness of proposed approach.

5. Conclusion and future work

Underwater sea images need to be pre-processed due to many factors. Various kind of filters upto a precision are available till now. In this paper unsharp

Method	PSNR	MSE	Images
Modified laplacian Filter	85.6603	1.7662e-004	Shark.jpg
	53.3030	0.3039	Grass.jpg
	87.8378	1.0698e-004	Titanic.png
	42.4008	3.7411	Fishe.bmp
Laplacian Filter	23.4088	296.6207	Shark.jpg
	17.5683	1.1383e+003	Grass.jpg
	35.4906	18.3664	Titanic.png
	15.4234	1.8653e+003	Fishe.bmp
Homomorphic Filter	5.8567	1.6882e+004	Shark.jpg
	5.0305	2.0419e+004	Grass.jpg
	10.7200	5.5091e+003	Titanic.png
	9.3529	7.5472e+003	Fishe.bmp
Bilateral Filter	25.2914	192.2843	Shark.jpg
	16.9487	1.3128e+003	Grass.jpg
	23.1596	314.1363	Titanic.png
	16.7360	1.3787e+003	Fishe.bmp

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masking technique has been proposed to sharpen such

images. From the results shown above it can be concluded that PSNR value for proposed filter is much better in comparison with available filters. The images shown in result section shows that the quality of image obtained after applying proposed filter is also better then available filters. In proposed technique focus is onm edge sharpening of sea water images bt still there are so many factors which also degrades the quality of sea water images. In future work can be extended to improve the quality by aiming at other factors like contrast stretching, Light illumination etc.

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