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Under Water Image Enhancement by Colour Convolution with Total Variation

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Abstract*:* ***Due to concern about the current state of the world's oceans, several large-scale scientific projects have begun to investigate the condition of our oceans. These projects are making use of underwater video sequences to monitor marine species. The move to using underwater video monitoring introduces labour intensive manual processing techniques. This leads to the need for an automated system capable of processing the data at a much greater speed. This thesis investigated whether the development of suitable image processing techniques could be used for pre-processing underwater images which enhance the image. The main objective of this thesis reduce the noise ratio and increase the PSNR of the image. In underwater situations, clarity of images is degraded by light absorption and scattering. This causes one colour to dominate the image. In order to improve the perception of underwater images. Improve the colour noise by convolution method which reduces the colour blurriness and total variation (TV) improve the noise after blurriness we get the significance improvement in PSNR from existing method approximate multiple five increments of PSNR.***

Keywords*:* ***PSNR, Image, Underwater, MSE, Noise.***

I. INTRODUCTION

Digital image processing is a broad subject and often involves procedures which can be mathematically complex, but central idea behind DIP is quite simple. The aim of image processing is to use data contained in the image to enable the system to understand, interpret and recognize the processed information available from the image pattern. Image enhancement can be applied to different areas of science and engineering. Nowadays there is a strong interest in knowing what lies in underwater, and moreover, this field has made an importance to the use of underwater sequences to monitor marine species, underwater mountains & plants, to achieve this purpose it is absolutely necessary to use the clear images.

Enhancement of underwater images requires modeling and estimation of the water absorption and scattering characteristics to remove the haze. A major difficulty in processing underwater images comes from light attenuation. Light attenuation limits the visibility distance, at about twenty meters in clear water and five meters or less in turbid water. The light attenuation process is caused by the absorption (which removes light energy) and scattering (which changes the direction of light path).

Absorption and scattering effects are due to the water itself and to other components such as dissolved organic matter or small observable floating particles. Dealing with this difficulty, underwater imaging faces to many problems. First, the rapid attenuation of light requires attaching a light source to the vehicle providing the necessary lighting. Unfortunately, artificial lights tend to illuminate the scene in a non-uniform fashion producing a bright spot in the center of the image and poorly illuminated area surrounding.
Then the distance between the camera and the scene usually induced prominent blue or green colour (the wavelength corresponding to the red colour disappears in only few meters). Then, the floating particles highly variable in kind and concentration, increase absorption and scattering effects: they blur image features (forward scattering), modify colours and produce bright artifacts known as "marine snow. At last the non-stability of the underwater vehicle affects once again image contrast.

It is found that image enhancement is one of the most important issues in low-level image processing. In some algorithm basically, enhancement methods were classified into two classes: global and local methods. In such work, the multi-peak generalized histogram equalization is proposed. [2] The global HE is improved by using multi-peak histogram equalization combined with local information. These enhancement methods are based either on local information or on global information. Such approach used both local and global information to enhance the image. This method adopts the traits of existing methods. It also makes the degree of the enhancement completely controllable.

II. LITERATURE REVIEW

Haocheng Wen et al [1]: As light is attenuated when disseminating in water, the clarity of images or videos captured under water is usually degraded to varying degrees. By exploring the difference in light attenuation between in atmosphere and in water, we derive a new underwater optical model to describe the formation of an underwater image in the true physical process, and then propose an effective enhancement algorithm with the derived optical model to improve the perception of underwater images or video frames. In our algorithm, a new underwater dark channel is derived to estimate the scattering rate, and an effective method is also presented to estimate the background light in the underwater optical model. Experimental results show that our algorithm can well handle underwater images, especially for deep-sea images and those captured from turbid waters.

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Mahendra PS Kuber and Manish Dixit [2]: The aim of image enhancement is to or to provide 'better' input for other improve the interpretability or perception of information in images for human viewing automated image processing techniques. Various Histogram Equalization techniques like CHE, GHE, BBHE, DSIHE, RMSHE and Multi-HE techniques are used for processing the image input to enhance its output. This paper provides a review of the modification of the brightness preserving dynamic histogram equalization technique to improve its brightness preserving and contrast enhancement abilities while reducing its computational complexity. There are much modified techniques related to brightness preserving dynamic Histogram Equalization that uses statistics of digital images for their representation and processing are discussed here. Representation and processing of images in the spatial domain enable the technique to handle the inexactness of gray level values in a better way, resulting in improved performance.

Pooja Sahu et al [3]: This review paper deals with the methods to improve underwater image enhancement techniques, the processing of an underwater image captured is necessary because the quality of underwater images affect and these image leads some serious problems when compared to images from a clearer environment. A lot of noise occurs due to low contrast, poor visibility conditions (absorption of natural light), non-uniform lighting and little colour variations, pepper noise and blur effect in the underwater images because of all these reasons number of methods are existing to cure these underwater images different filtering techniques are also available in the literature for processing and enhancement of underwater images one of them is image enhancement using median filter which enhances the image and helps to estimate the depth map and improve quality by removing noise particles with the help of different techniques, and the other is RGB Colour Level Stretching have used. Forward USM technique can also be used for image enhancement. The approached used i.e. median filter [13] which is used to estimate the transmission of the input image. The atmospheric light is obtained by using dark channel prior. Further improvement a colour correction quality is employed to enhance the colour contrast of the object in underwater and remove different noise particles. In order to increase the efficiency of underwater images and improve the quality and to get more sharper and accurate images, as per the study in the future we can work in the sequence of the existing methods for underwater images make more clearer and sharper that the use USM filtering technique.

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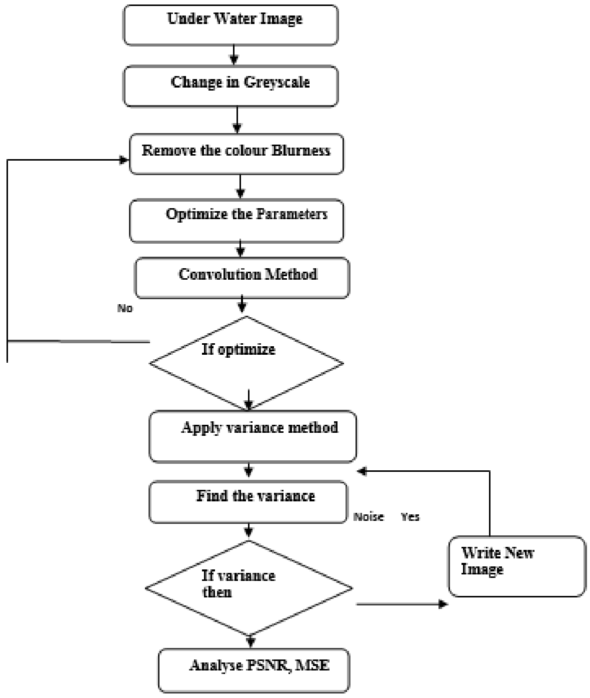
Iqbal, K et al [4]: worked on "Enhancing the low-quality images using Unsupervised Colour Correction Method,", The affected underwater images reduced contrast and non-uniform colour cast because of the absorption and scattering of light rays in the marine environment. For that, they proposed an Unsupervised Colour Correction Method (UCM) for underwater image quality enhancement. UCM is based on colour matching, contrast improvement of RGB colour model and contrast improvement of HSI colour model. Firstly, the colour cast is concentrated by equalizing the colour values. Secondly, an improvement to a contrast alteration method is useful to increase the Red colour by stretching red colour histogram towards the utmost, similarly, the Blue colour is concentrated by stretching the blue histogram to the minimum. Thirdly, the Saturation and Intensity parts of the HSI colour model have been useful for contrast correction to enlarge the true colour using Saturation and to address the illumination problem through Intensity.

Jinbo Chen et al [5]: proposed "A detection method based on sonar image for underwater pipeline tracker,". The surveillance and inspection of underwater pipelines are carried out by operators who drive a remotely operated underwater vehicle (ROV) with a camera mounted on it. Though in extremely turbid water, the camera cannot capture any scene, even with supplementary high-intensity light. In this case, the optical detection devices are unable to complete the surveillance task In recent years, forward looking sonar is broadly applied to the underwater examination, which is not subject to the control of light and turbidity. So it is appropriate for the inspection of pipelines. But the active change of ROV by the water flow will show the way to the aim to escape from the sonar image effortlessly. In adding up, the sonar image is with high noise and little contrast. It is difficult for the operator to identify the pipeline from the images. Furthermore, the observation of underwater pipelines is deadly and time unbearable and it is easy to create mistakes due to the exhaustion and interruption of the operator. Then, the study focuses on rising image processing algorithms to distinguish the pipeline repeatedly. By means of the proposed image processing technique, firstly the images are improved using the Gabor filter.

Hung-Yu Yang et al [6]: worked on "Low Complexity Underwater Image Enhancement Based on Dark Channel Prior,". The blurred underwater image is always an irritating problem in the deep-sea engineering. They proposed a competent and low complexity underwater image enhancement technique based on the dark channel before. Our technique employs the median filter in its place of the soft matting method to estimate the depth map of the image. Furthermore, a colour improvement method is adopted to improve the colour contrast for the underwater image. The tentative results show that the proposed approach can well improve the underwater image and decrease the implementation time. In addition, this technique requires fewer computing reserve and is well appropriate for implementing on the supervision and underwater navigation in real time.

Chiang, J.Y et al [7]: researched on "Underwater Image Enhancement by Wavelength Compensation and Dehazing,". Where light scattering and colour modify are two main sources of alteration for underwater shooting. Light scattering is affected by a light event on objects reflected and deflected many times by particles present in the water prior to reaching the camera. This, in turn, lowers the visibility and contrast of the image captured. Colour change corresponds to the unstable degrees of reduction encountered by light traveling in the water with diverse wavelengths, depiction ambient underwater environments conquered by a bluish quality. No obtainable underwater processing techniques can handle light dispersion and colour change distortions caused by underwater images, and the probable presence of false lighting concurrently. This literature proposed a novel systematic come up to improve underwater images by a de-hazing algorithm, to give back the attenuation difference along the broadcast path, and to take the pressure of the possible presence of a false light source into consideration. Previously the deepness map, i.e., distances between the objects and the camera, is expected, the foreground and background within a view are segmented. By managing the effect of artificial light, the haze occurrence and inconsistency in wavelength attenuation along the underwater broadcast path to the camera are corrected. Secondly, the water deepness in the image scene is predictable according to the remaining energy ratios of diverse colour channels obtainable in the background light.



IV. RESULTS AND DISCUSSIONS

Table 1: Existing Recursion Method

Images	PSNR(Recursion)	MSE (Recursion)
Image2	6.3602	15.033
Image3	15.92	16.507
Image4	10.877	53.15
Image5	17.383	12.002
two fish	14.955	20.77

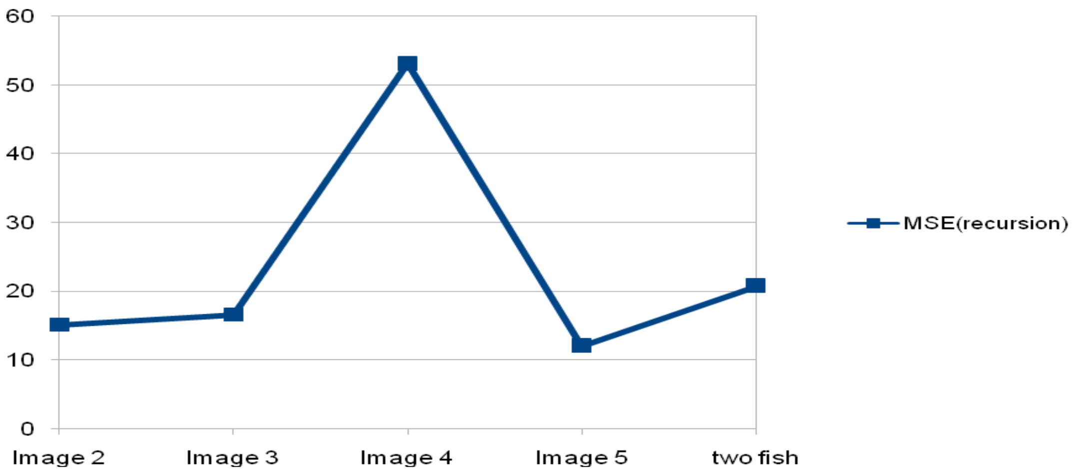
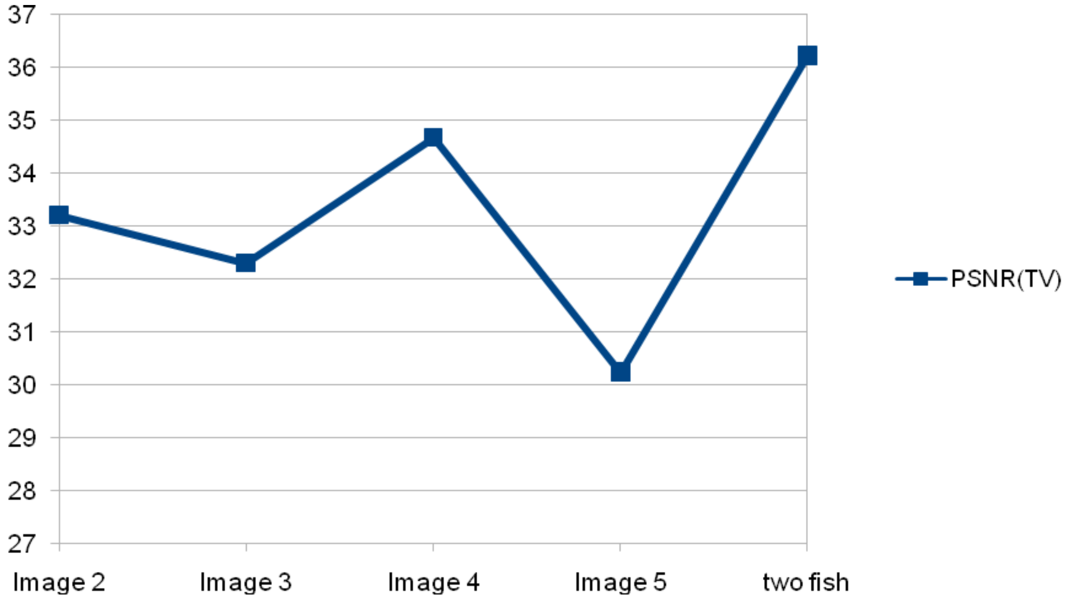
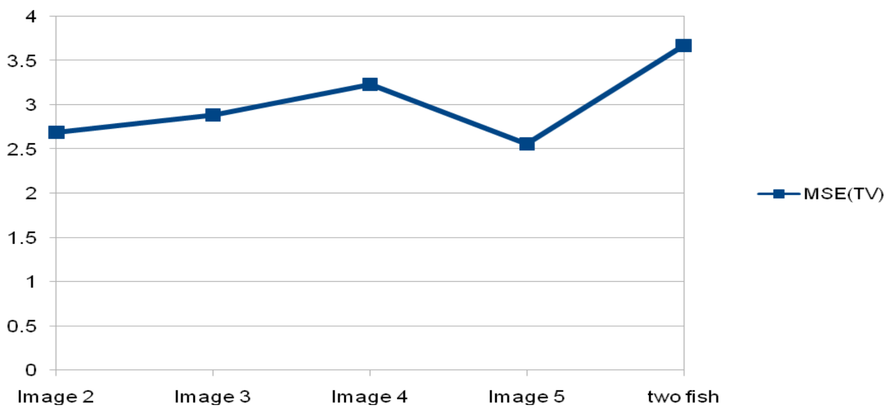


Table 2: Consultation with Total Variation

Images	PSNR(TV)	MSE(TV)
Image	33.209	2.6902
Image	32.3	3.23
Image	30.23	2.56
Two fish	36.23	3.67





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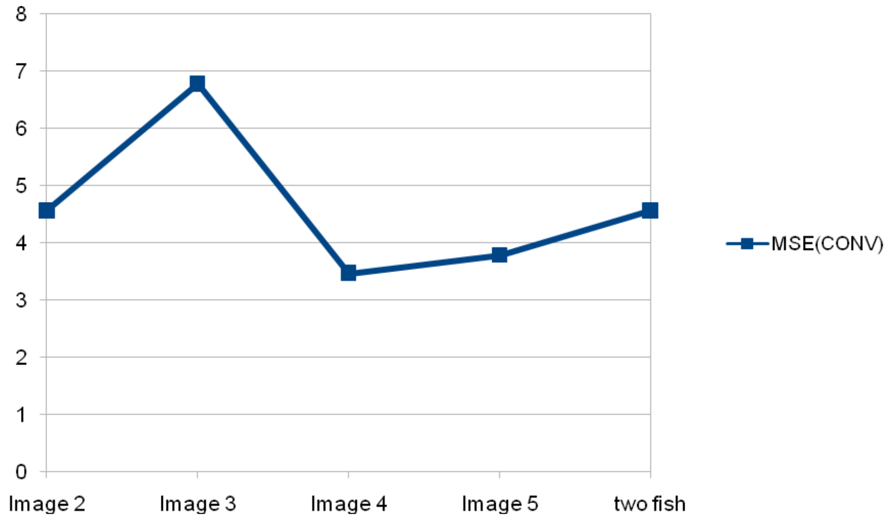


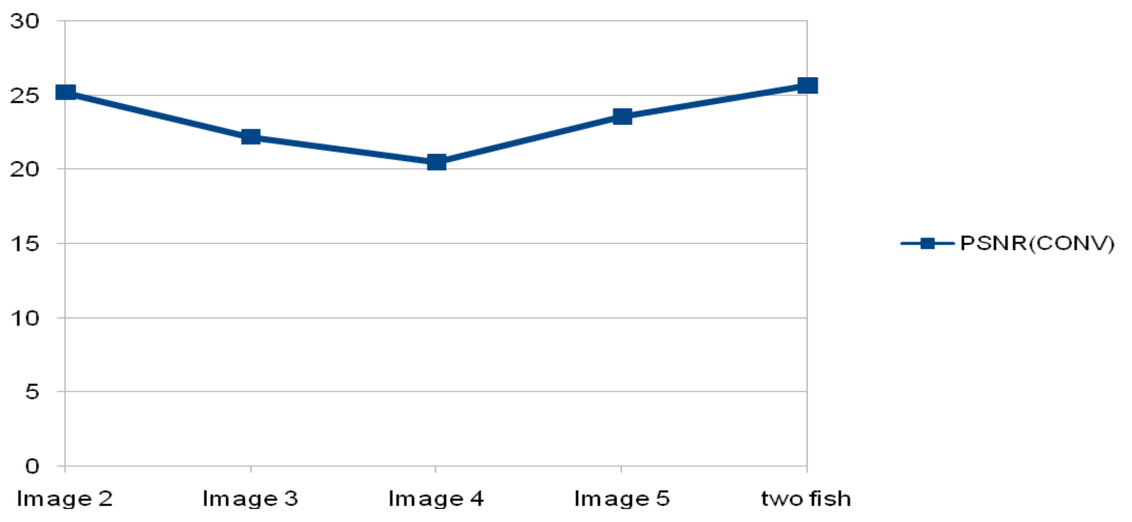
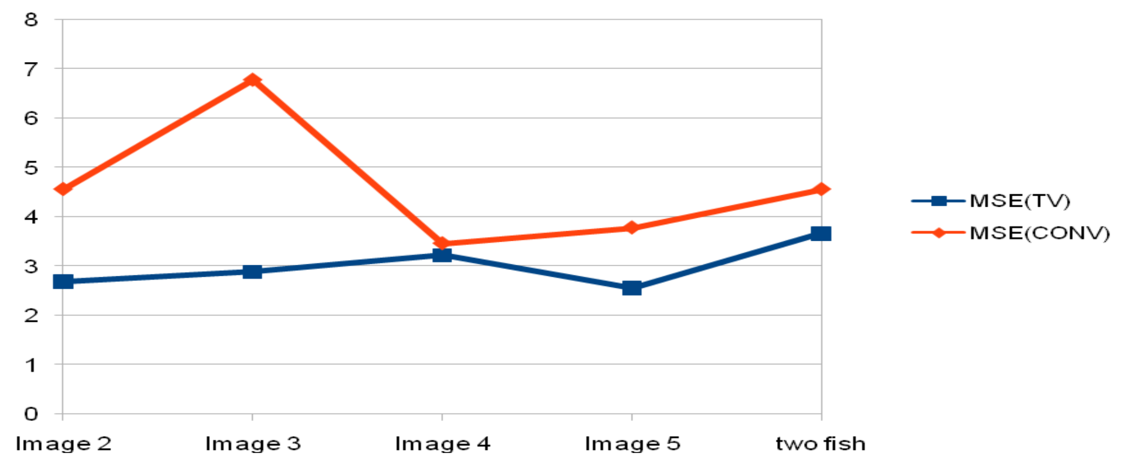
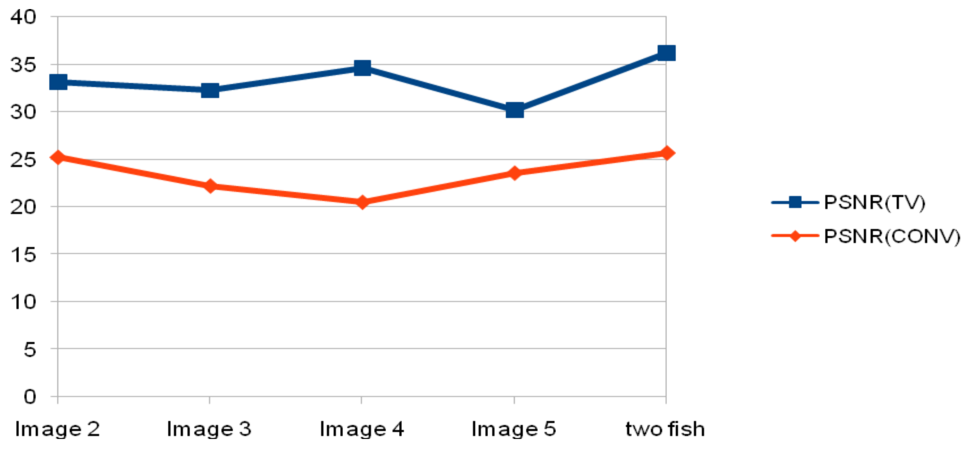
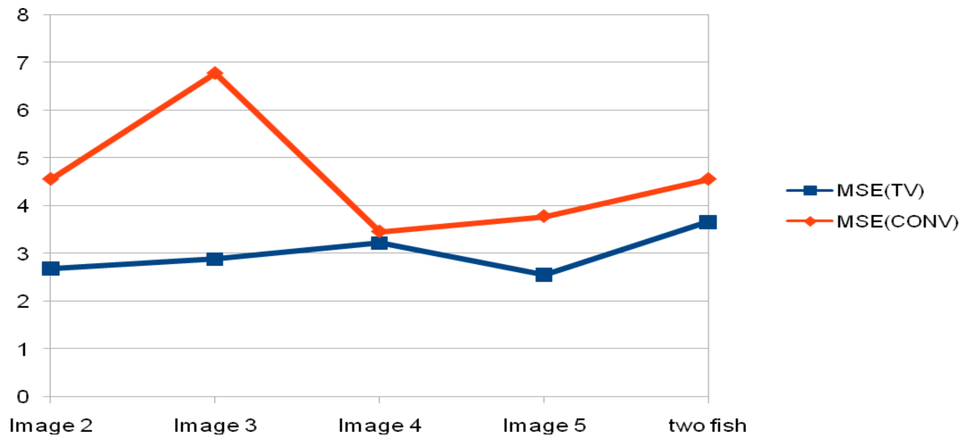


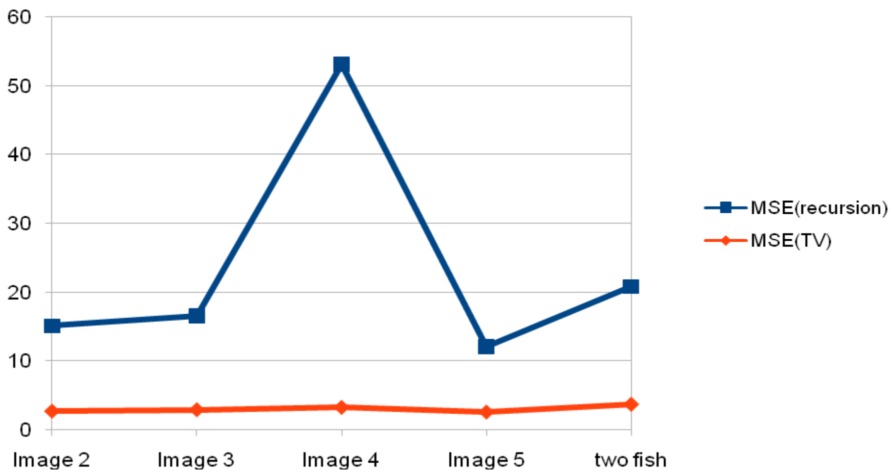
Table 4: Comparison between recursion, total variation and convolution method

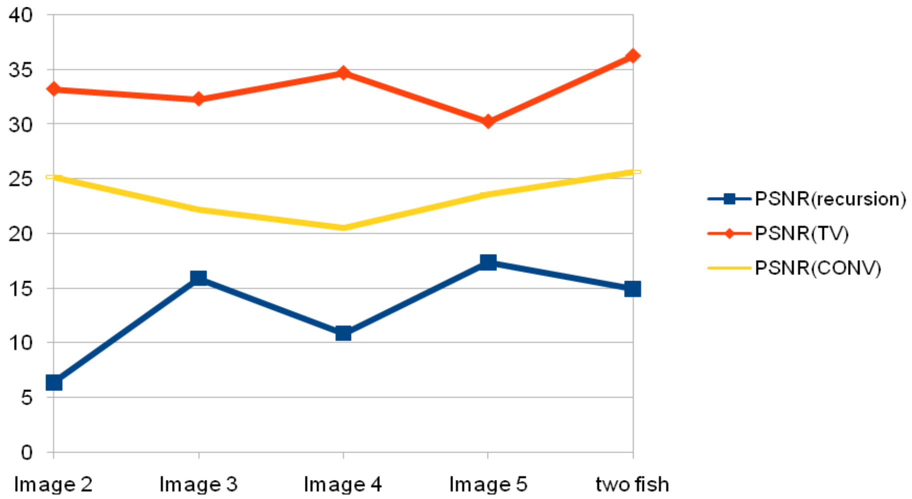
Images	PSNR(recursion)	PSNR(TV)	PSNR(CONV)	MSE(recursion)	MSE(TV)	MSE(CONV)
Image2	6.3602	33.209	25.209	15.033	2.6902	4.56
Image3	15.92	32.3	22.206	16.507	2.89	6.78
Image4	10.877	34.67	20.5	53.15	3.23	3.46
Image5	17.383	30.23	23.56	12.002	2.56	3.78
Two fish	14.955	36.23	25.67	20.77	3.67	4.56

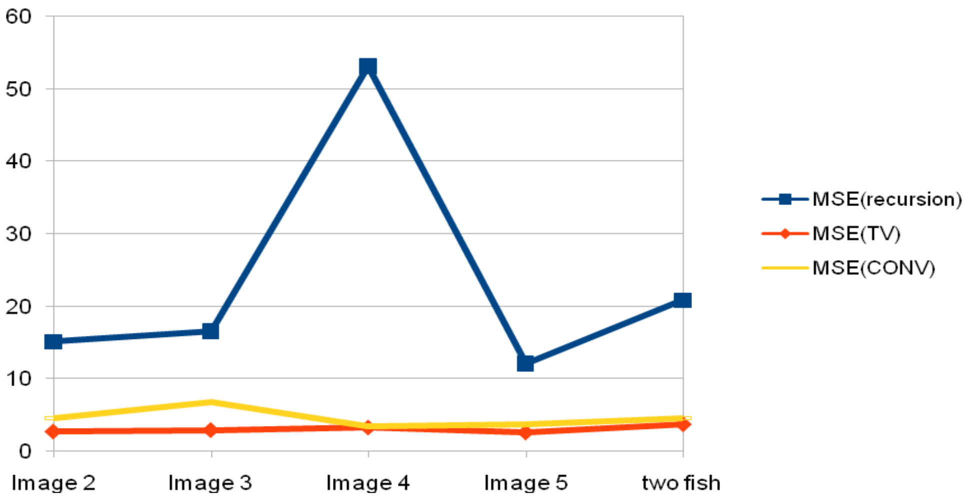



40
35
30
25
20
15
10
5
0
Image 2
Image 3
Image 4
Image 5
two fish
PSNR(TV)
PSNR(CONV)


8
7
6
5
4
3
2
1
0
Image 2
Image 3
Image 4
Image 5
two fish
MSE(TV)
MSE(CONV)


60
50
40
30
20
10
0
Image 2
Image 3
Image 4
Image 5
two fish
MSE(recursion)
MSE(TV)





CONCLUSIONS

The difficulty associated with obtaining visibility of objects at a long or short distance in underwater scenes presents a challenge to the image processing community. Even if numerous approaches for image enhancement are available, they are mainly limited to ordinary images and few approaches have been specifically developed for underwater images. in this thesis enhance the underwater image colour blurriness and noise by a hybrid method of convolution and TV (total variation), which reduce the mean squared error and increase the PSNR.

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