International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

UNDERWATER IMAGE ENHANCEMENT USING PCNN AND NSCT FUSION

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Abstract – *Our work is a good technique to reinforce the pictures taken underwater and tarnished because of the medium scattering and immersion. It builds on the blending of two images that are directly derived from a color compensated and chromatic adapted version of the first degraded image. Image fusion methods supported Non-Subsampled Contourlet Transform (NSCT) and perform alright for gray scale images. In this paper, a replacement method multi-focus image fusion is proposed that's suitable for color images using NSCT and Pulse Coupled Neural Network (PCNN). Proposed justification also verifies that our algorithm is fairly autonomous of the camera settings, and progresses the accuracy of several image processing applications, like image segmentation and key point matching.*

Key Words: Image Processing, Image Fusion, Multi-focus, Non-Subsampled Contourlet Transform, Pulse Coupled Neural Network, Underwater.

1. INTRODUCTION

Underwater images are hampered by poor contrast, colour change, suspended and floating particles. Particularly with cameras mounted on ROV and AUV systems has widespread in civil and military applications The contrast and fidelity of the image are attenuated to different degrees, which directly affects the perception of human operators and also the performance of the machine vision system [3][8].

Different wave lengths of sunshine cause various degrees of attenuation and also the most visible colourise the water is blue. Subsequently, with light scattering and deviation of colour ends up in the contrast loss within the captured images. Image development techniques like histogram equalisation, wavelet transform theory, bilateral filtering theory, dark channel prior theory, Retinex theory like numerous image processing methods are proposed [4].

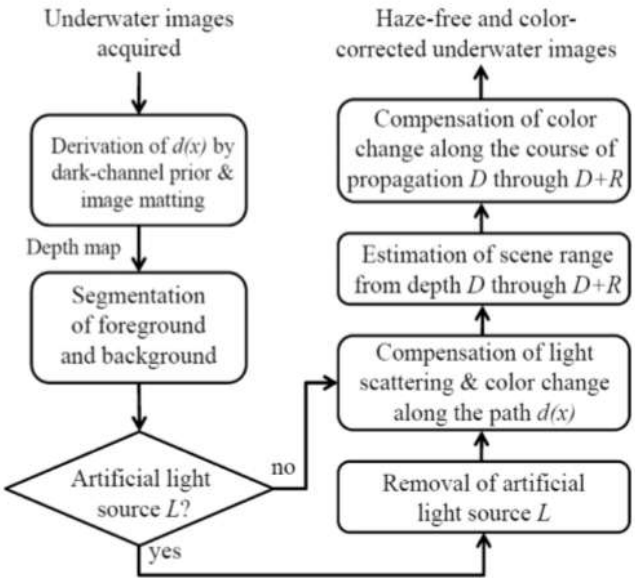
There are only a few studies regarding the fidelity of enhanced images, and also the distortion issues created by image enhancement haven't been carefully studied as of yet. A widely accepted model represents the resulting hazy image as a convex combination of true colour and ambient light [2]. Numerous spatial domain methods are developed to filter out the aforementioned image quality impairments. Another method to scale back colour cast is predicated on the Beer's law. Beer's law is often employed to correct the pixel intensity by calculating the quantity of sunshine absorption in water [9].

2. IMAGE ENHANCEMENT TECHNIQUES:

A. Wavelength Compensation

The major source for the distortion for underwater shooting change in colour and scattering of light. The scattering of light is caused due to the reflection and refraction of the particles in water.

In wavelength compensation method before taking a photograph the scene background and the foreground are separated and the light intensities are compared to detect whether an artificial light source is employed during the image capturing. After the comparison the water depth is estimated using the residual ratios and based on the attenuation corresponding to each wavelength the colour balance of the given captured image is restored [6].



1.Flowchart of the WCID algorithm

B. Multi Band Fusion

The Multi band fusion technique is nothing but the combination of the model based and the fusion based dehazing methods to provide a balanced image enhancement. The Laplacian modules and the intensity of the layers are extracted using the Multi band decomposition. The true intensity is restored by an effective intensity module from the ambient map.

In this multi band fusion the image is validated based on terms of comparison of the conventional image quality. Semantic scene understanding can be done using this approach [2].

C. Conventional Technique with Quality Metrics

The quality metrics approach is an image enhancement technique where the intensity levels of the original image are increased gradually thereby increasing the quality of the image or the part of the image which results in a quality image than the captured original image during the acquisition process.

The edges and pattern in the images are detected by the quality metrics. The external and the internal property of the underwater such as the light scattering, suspended particles in the water, artificial light provide a low contrast or a dim image which dominates the entire image and the clarity of the image is decreased because of it. The quality of the degraded image is increased in the pre-processing step [7].

D. Image Mode Filtering

Image mode filtering is an image improvement technique which can be used to filter the forward and backward scattering of the sunshine, sea snow etc. Many different solutions for this problem have been proposed to overcome this issue. Among the various solutions proposed the detailed information about the image captured is given by the depth map technique.The work involved in image mode filtering is a Kinect based underwater depth map estimation which gives the output of image with a loss of depth information.

The disadvantages of coarse depth map a model that uses in-painting weighted enhanced image mode filtering, underwater dual channel prior dehazing model, in-painting [5].

E. MSRCR

The ability which is used to process to render an image accurately is known as the Image Fidelity. Thus implementing and understanding this process various algorithms and solutions have been developed to evaluate the fidelity of the enhanced the images produced by the proposed algorithms. The method used to evaluate the fidelity of enhanced images is known as Image Quality Assessment. Under this topic many methods inhabiting the fidelity evaluation have been proposed.

There are three components which are used in the image fidelity framework. Those components are colour fidelity, Constituent fidelity, the information entropy fidelity. MSRCR is abbreviated as Multi-Scale Retinex with Colour Restoration. IQA database is used to evaluate the rationality of the fidelity criteria. After evaluation those results were productive and implied that the method used for evaluation matched with subjective assessment. Only after these steps the effectiveness of the method is verified using MSRCR. The experimental results suggest that the image quality can be improved by MSRCR [4].

F. Patch-Structure Representation

Accurate Predictions on the human perception of contrast variations can be verified or processed by the efficient method known as the Patch-Based Contrast Quality Index (PCQI). In this method the validation is done based on the four publicly available databases which makes this method an efficient method outperforming the other existing methods.

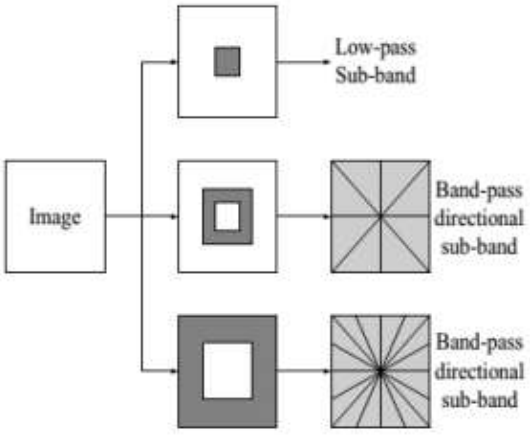
The difference between the existing approaches and the Patch based Contrast Quality Index is that they rely completely on the global statistics to estimate the contrast quality whereas this method uses adaptive representation of local path structure which provides the novel local patch-based quality assessment which allows us to find the mean intensity, signal strength, signal structure components based on the decomposition of any image patch and the perceptual distortions can be evaluated in different ways. The unique and the important property of the patch structure representation is that it has the capability to produce a local contrast quality map, which will help to predict the local quality variations over space, which outperforms the existing contrast quality models [12].

3. TECHNOLOGIES

A. Non-Subsampled Countourlet Transform

NSCT is used to decompose the given image into coefficients known as the low pass sub-band and band-pass directional coefficients. NSCT comprises of two major methods or methodologies which are non-sub sampled directional filter bank (NSDFB), non-sub sampled pyramid filter bank (NSPFB) which gives the anisotropic and frequency, multi directional and multi scale, localized information of the input image also effectively overcomes pseudo gibbs phenomenon. Figure 2 below shows detailed schematic diagram of NSCT decomposition of the given image.

Two channel non-sub sampled filter bank gives multi scale information to NSPFB. At each decomposition level, NSPFB gives one low frequency sub image and one high frequency sub image. For k-level decomposition, NSPFB gives k+1 sub images i.e., one low frequency sub image and k high frequency sub images of same size as that of the input source image. NSDFB give precise directional detail information combining directional fan filters. NSDFB performs l-level decomposition of the high frequency sub image obtained from NSPFB and produces 2l band pass directional sub images with same size of input sourceimage[13].



2.Non-Sub Sampled Countourlet Transform

B. Neural Networks

A neural network could be a series of algorithms that endeavors to acknowledge underlying relationships in an exceedingly set of information through a process that mimics the way the human brain operates. during this sense, neural networks confer with systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input; so, the network generates the simplest possible result with no need to revamp the output criteria. In the development of trading system, the concept of neural network which has the roots in the AI is gaining popularity.

A "neuron" in an exceedingly neural network could be a function that collects and classifies information in step with a selected architecture. The network bears a powerful resemblance to statistical methods like curve fitting and multivariate analysis [14].

i. Pulse Code Neural Network

High frequency components of a picture usually give information about edges, textures, boundaries etc. Selecting the most effective method for fusion of high pass sub band coefficients yields better quality fused image. in numerous multi scale transform image fusion methods it's found that PCNN based image fusion method perform better than the opposite two in terms of objective and subjective quality assessment. PCNN is feedback network which may be a model of visual area of mammalians. PCNN may be a self-organizing network, so no learning required. PCNN consists of three parts: receptive field, modulation field and generator. Through the receptive field, neuron receives input signals from feeding and linking inputs through.

A PCNN may be a two-dimensional neural network. Each neuron within the network corresponds to 1 pixel in an input image, receiving its corresponding pixel's color information (e.g. intensity) as an external stimulus. Each neighboring neurons connects with each other neurons, in order to receive the local stimuli from them. The external and native stimuli are combined in an indoor activation system, which accumulates the stimuli until it exceeds a dynamic threshold, leading to a pulse output. PCNN neurons produce temporal series of pulse outputs through iterative computation. The information input images were present in the temporal series of pulse outputs and it might be used for various applications like image segmentation and have generations. PCNNs have several significant qualities compared with conventional image processing, including toughness against noise, independence of symmetrical variations in input patterns, capability of linking minor intensity variations in input patterns, etc. [14].

ii. Convolutional Neural Network

Convolutional neural network is a class of deep neural networks, which is most characteristically applied to the analyzing visual imagery, they need applications in image and video recognition, recommender systems, image

classification, medical image analysis, linguistic communication processing, and financial statistic. The convolutional neural network indicates that the network implements a computing called convolution. Convolution may be a specialized quite linear operation. Convolutional neural network use general matrix operation in minimum of one in all other present layers.

CNNs are regularized versions of multilayer perceptrons. Multilayer perceptrons usually mean fully connected networks, that is, each neuron in one layer is connected to any or all neurons within the next layer. The "fully-connectedness" of those networks makes them at risk of overfitting data. Typical ways of regularization include adding some kind of magnitude measurement of weights to the loss function. CNNs take an exclusive methodology towards regularization: they profit of the graded pattern in data and gather more composite patterns using smaller and simpler patterns. Therefore, on the scopes of connectedness and complexity, CNNs are on the inferior extreme.

Convolutional networks were inspired by biological processes therein the connectivity pattern between neurons resembles the organization of the animal visual area. Individual cortical neurons reply to stimuli only in a very restricted region of the sight view called the receptive field. The receptive fields of various neurons partially overlap such they cover the whole sight view. Compared to other image classification algorithms CNNs use temperately little pre-processing. this suggests that the network learns the sieves that in traditional algorithms were hand-engineered. This independence from preceding knowledge and human effort in feature design may be a main advantage [15].

4. CONCLUSIONS

We have offered an alternative approach to boost underwater images. Our strategy builds on the newest fusion principle and does not require added information than the single original image. We have shown in our experiments that our approach is able to enhance a wide range of underwater images (e.g. different cameras, depths, light conditions) with high accuracy, being able to recover important faded features and edges. Moreover, for the first time, we demonstrate the utility and relevance of the proposed image enhancement technique for several challenging underwater computer vision applications. In this study, multi focus colour image fusion is done in NSCT transform domain, where SML based rule is used to fuse low pass sub band coefficients and PCNN is used to fuse high pass sub band coefficients. Some experiments have been done in order to compare the quality of fused image based on different objective assessment evaluation criteria, based on these objective evaluation criteria it is clear that the proposed method based on NSCT and PCNN outperforms the other methods. The execution time of PCNN is more or less same as the existing methods.

REFERENCES

[1] Vasit Sagan, Maher Qumsiyeh, Maitiniyazi Maimaitijiang , Almabrok Essa , Vijayan Asari, “Adaptive Trigonometric Transformation Function With Image Contrast and Color Enhancement: Application to Unmanned Aerial System Imagery by Paheding Sidike” Published in: IEEE Geoscience and Remote Sensing Letters (Volume: 15, Issue: 3, March 2018).

[2] Younggun Cho, Jinyong Jeong , Ayoung Kim, “Model-Assisted Multiband Fusion for Single Image Enhancement and Applications to Robot Vision” Published in: IEEE Robotics and Automation Letters (Volume: 3, Issue: 4, Oct. 2018)

[3] Faliang Chang, Tao Ji, Xiaojin Wu, “A Fast Single-Image Dehazing Method Based on a Physical Model and Gray Projection by Wencheng Wang” Published in: IEEE Access (Volume: 6-- 16 January 2018)

[4] Yuhong Liu, Hongmei Yan, Shaobing Gao, Kaifu Yang, “Criteria to evaluate the fidelity of image enhancement by MSRCR” Published in: IET Image Processing (Volume: 12, Issue: 6, 6 2018)

[5] Huimin Lu, Yin Zhang, Yujie Li , Quan Zhou, Ryunosuke Tadoh, Tomoki Uemura, Hyoungseop Kim “Depth Map Reconstruction for Underwater Kinect Camera Using Inpainting and Local Image Mode Filtering” Published in: IEEE Access (Volume: 5) 04 April 2017

[6] John Y. Chiang, Ying-Ching Chen, “Underwater Image Enhancement by Wavelength Compensation and Dehazing”
Published in IEEE Transactions on Image Processing (Volume: 21, Issue: 4, April 2012)

[7] M Sudhakar, M Janaki Meena, “Underwater Image Enhancement using Conventional Techniques with Quality Metrics” International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8, Issue-7S, May 2019

[8] Ranjit Ray, Siva Ram Krishna Vadali, Sankar Nath Shome and Sambhunath Nandy, “Real-time underwater image enhancement: An improved approach for imaging with AUV-150” Published in International Journal Sadhana in 26 September 2015

[9] Y. Li, H. Lu, J. Li, X. Li and S. Serikawa, “Underwater image de-scattering and classification by a Deep neural network”, Comput.Electr.Eng., vol. 54,pp.68-77,Aug.2016.

[10] J.-B. Huang, A. Singh, and N. Ahuja, "Single image super resolution from transformed self-exemplars" in Proc. IEEE CVPR, Jun.2015, pp. 5197-5206.

[11] C.Ancuti, C. O.Ancuti, C.De Vleeschouwer, and A. Bovik, "Night-time dehazing by fusion," in Proc. IEEE ICIP, Sep. 2016,pp. 2256-2260.

[12] S. Wang, K. Ma, H. Yeganesh, Z. Wang, and W.Lin, "A patch structure representation method for quality assessment of contrast changed images," IEEE Signal Process. Lett., vol. 22, no.12,pp.2387-2390,Dec.2015.

[13] Yan Zhou, Qingwu Li, Guanying Hou "Human Visual System Based Automatic Underwater Image Enhancement in NSCT domain", KII Transactions on Internet and Information Systems, Vol 10, NO.2, Feb.2016. [14] Kangjian He, Ruxin Wang, Dapeng Tao, Jun Cheng, Weifeng Liu, "Color Transfer Pulse-Coupled Neural Networks for Underwater Robotic Visual Systems" IEEE Access(Volume: 6), June 2018.

[15] Young Shik Moon, Bok Gyu Han, Hyeon Seok Yang, Ho Gyeong Lee, "Low Contrast Image Enhancement Using Convolutional Neural Network with Simple Reflection Model", published in Advances in Science, Technology and Engineering Systems Journal Vol. 4, No. 1, 159-164 (2019).