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Detection and Removal of Shadows for Side Scan Sonar Images by Effective Image Processing Algorithms

Vikas .A
M.Tech Student,
Department of ECE,
vikasav72@gmail.com

Abstract: ***This paper proposes the designing of an effective image processing algorithms for removal of shadows generated around the image. Usually, Side Scan Sonar is used for ocean investigations like surveys for marine archaeology, mining, drowned objects at the sea floors, pipeline, underwater communications, fisheries research, environmental studies etc. This paper makes use of Fuzzy C-Means Clustering for shadow region detection and Inpainting algorithm to compensate the shadow region. Thus a clear image can be obtained.***

Keywords: Side Scan Sonar, Fuzzy C-means Clustering, Inpainting.

1. INTRODUCTION

Usually, underwater objects are detected by side-scan sonar [1],[6].Side scan sonar devices are works on the principle of transmitting the sound waves that vibrate at frequency 100Khz to 1Mhz through the sea floor and receives the echo's from the objects and maps into the rainbow-colored images or 3D maps based on the Computer mapping software.

These images may accompany by acoustic shadows around the detected objects and this can degrade the definiteness or shape of the object.

The structure of the paper is as follows: Section-2 describes the objective of the proposed method. In section-3 Methodology is interpreted and also algorithms are explored. In Section-4 shows the simulation results and analysis and finally, the conclusion is written in Section-5.

2. OBJECTIVE

1. To develop an algorithm for shadow region detection. Here Fuzzy C-means clustering [4], [5],[8],[9],[10],[11] is used for shadow region extraction.
2. To develop an algorithm for the shadow region compensation. Here in the painting is used. A patch based Criminisi algorithm [2], [3], [12] is applied for shadow region filling.

3. METHODOLOGY

Initially, this work composed of the preprocessing, it includes image resizing, image enhancement and RGB to GREY conversion. This can be done by the MATLAB commands. Thus the result obtained is clustered for shadow region segmentation. Then is to fill the Shadow region by Inpainting i.e., Criminisi algorithm.

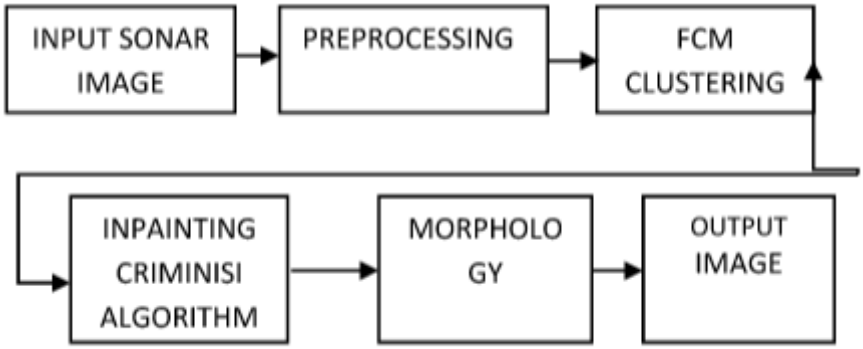

FIG-1: BLOCK DIAGRAM OF PROPOSED SCHEME

A. A.FUZZY C-MEANS CLUSTERING ALGORITHM(FCM)

FCM was first proposed by Dunn and further improvements are done by Bezdek. FCM method segment the image into several clusters based on the degree of their belongings to the cluster rather than the binarization (0 & 1).The advantage of FCM includes, Clustering is dividing the image into segments.

1. Tolerate imprecise data.
2. Can model the nonlinear function.
3. Flexibility.

IMPLEMENTATION OF FCM

1. Initialize centroid randomly for the first time depending on the number of clusters required for efficient shadow region segmentation.
2. Calculate the degree of membership by using the centroid depending on the distance between the centroid and the input point.
3. Again calculate the degree of membership (Ui j) for the next iteration from the next centroid i to j in cluster is given by the equation

$$u_{ij} = \frac{1}{\sum_{k=1}^{C}\left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|}\right)^{\frac{2}{m-1}}} \qquad \text{----------1}$$

Cluster centroid is defined by the equation

$$c_j = \frac{\sum_{i=1}^{N} u_{ij}^{m}\, x_i}{\sum_{i=1}^{N} u_{ij}^{m}} \qquad \text{----------2}$$

4. Repeat the process till membership function of two successive iterations is same.

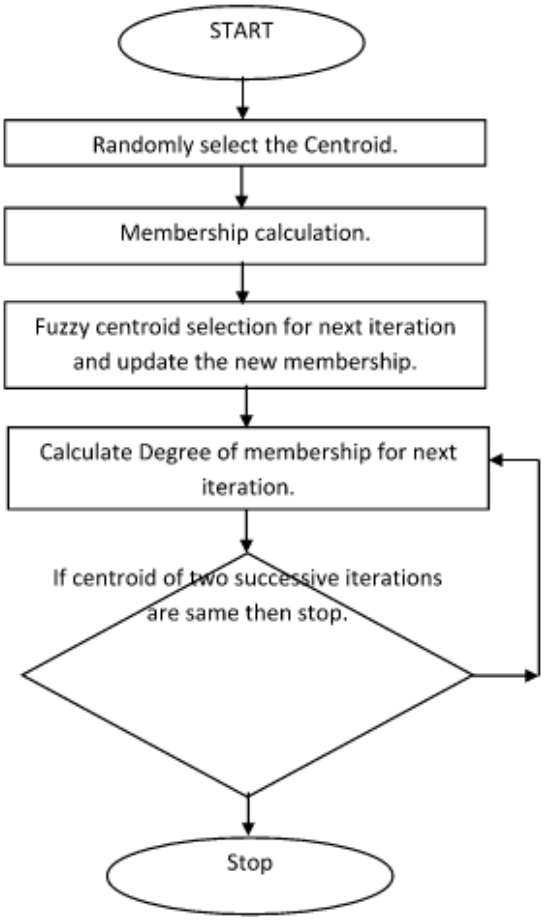

FIG-2: Flow Chart for Implementation of FCM

B. CRIMINISI ALGORITHM

The process of reconstruction of lost or wastage parts of images and videos. The process is called as Image Inpainting. Criminisi Algorithm can be used to fill in the shadow region left behind the object. It can generate the both linear and texture from the known surrounding region into the shadow region.

Criminisi algorithm removes the large objects from digital images and replaces them with possible backgrounds. It is a patch based on painting algorithm by generating the known image patches (i.e., exemplars) into the region need to be filled. The region needs to be filled, i.e., the targeted shadow region is represented as Ω, and its patch is denoted as δΩ.

In the Criminisi algorithm the priority function which is used for the best patch selection to fill the region is defined in as a Product form:

P (n) = K (n) x L (n) ----------3

K(n) denotes the suitable confident term of the patch and **L(n)** denotes the data term of the patch.

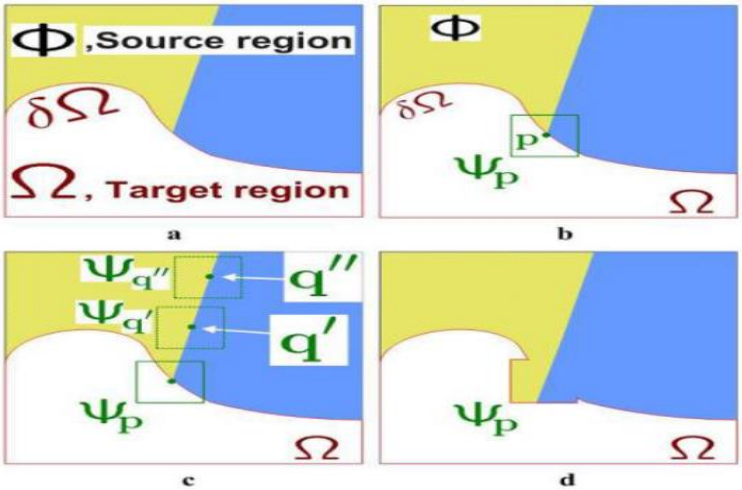

FIG-3: Procedure for Criminisi Algorithm

In the above figure first fig shows original image, the second image shows the region needs to be filled, the third image shows searching for best patch, the fourth image shows region replaced by the patch.

C. MORPHOLOGY

Morphology is structuring element to an input image value of each pixel at the input is compared and the output value is mapped. The objective of morphology is to remove the imperfections in the structure of the image. It combines of two operations, dilation and erosion. Matlab tool is used for implementing the morphology process.

Morphological operations are useful in many applications. They are used in hole filling, boundary extraction, extraction of connected components, thinning and thickening.

In the proposed technique morphology is used for softening of the patch boundaries of the Criminisi algorithm. So that it makes the boundaries smoother.

MATLAB software is used for shadow region segmentation, region filling, and morphology. Because MATLAB is flexible compared to other high-level languages. Data types are not required and directly can type the formula in the command window and get the output.

4. SIMULATION RESULTS

Fig-4: Side Scan Sonar Image

Fig-5: FCM Output Image

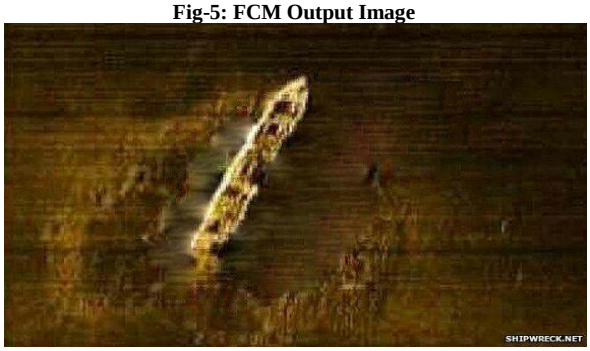

FIG-6: Inpainting Output

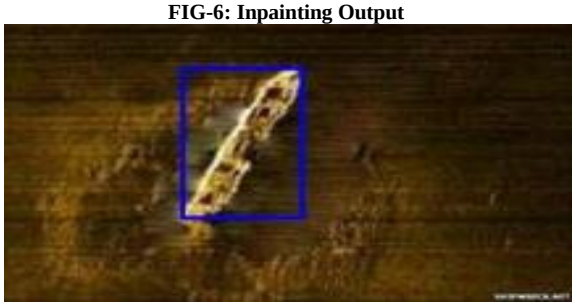

Fig-7: Detected Object

In simulation results, first sonar image is collected. FIG-4 shows the sonar image which has a shadow.FIG-5 illustrates the FCM clustering image, clusters are made to in order to get the shadow region here three segments are made and selects the second image for the further process.FIG-6 illustrates the inpainting result, shadow region is filled by the suitable background patch.FIG-7 shows the detected object by a rectangle box.

CONCLUSION

The proposed method can achieve a good performance with the efficient shadow region removal scheme for the side scan sonar images by making use of FCM and criminalise algorithm.Thus it provides a smoother path for shadow region.The proposed method could handle the problem of underwater image quality degradation.

REFERENCES

[1] Ruijie Chang, Yaomin Wang, Jiaru Hou, Shuqi,Qiu, RuiNian, Bo He, "Underwater Object Detection with Efficient Shadow-Removal for Side Scan Sonar Images" 978-1-4673-9724-7/16/$31.00 ©2016 IEEE

[2] A. Criminisi, P. Pérez, K. Toyama, "Region filling and object removal by exemplar-based image inpainting," Image Processing, IEEE Transactions on, 2004, 13(9): 1200-1212.

[3] A. Criminisi, P. Perez, K. Toyama, "Object removal by exemplar-based inpainting," Computer Vision and Pattern Recognition, 2003. Proceedings. 2003 IEEE Computer Society Conference on. IEEE, 2003, 2: II-721-II-728 vol. 2.

[4] H.H. Mohammed, "Unsupervised fuzzy clustering and image segmentation using weighted neural networks." Image Analysis and Processing, 2003. Proceedings. 12th International Conference on. IEEE, 2003: 308-313.

[5] J. C. Bezdek, R. Ehrlich, W. Full, "FCM: The fuzzy c-means clustering algorithm," Computers & Geosciences, 1984, 10(2): 191-203.

[6] S. Reed, Y. Petiliot, J. Bell, "Unsupervised mine detection and analysis in side-scan sonar: A comparison of Markov random fields and statistical snakes," Presented at CAD/CAC Conf., Halifax, Novia Scotia, Canada, Nov. 2001

[7] L.Q. Fu, Y.R. Wang, Z.B. Zhang, R. Nian, A. Lendasse, "A Shadow-Removal based Saliency Map for Point Feature Detection of Underwater Objects," OCEANS'15 MTS/IEEE Washington, 2015.(EI)

[8] V.J. Myers, "Image segmentation using iteration and fuzzy logic," Presented at CAD/CAC Conf., Halifax, Novia Scotia, Canada, Nov.2001

9]J.Selvakumar, A.Lakshmi, T.Arivoli, "Brain Tumor Segmentation and its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean algorithm", IEEE-International conference On Advances in Engineering, Science And Management(ICAESM-2012)March 303,31,2012.

[10]Chuen Rue Ng,Joel C.M.Than,Norliza Mohd Noor, Omar Mohd Rijal, "Double Segmentation Method for Brain Region Using FCM and Graph Cut for CT Scan Images",2015 IEEE International Conference on Signal and Image Processing Applications(ICSIPA).

[11]Maoguo Gong,Yan Liang,Jiao Shi,Wenping Ma and Jingjing Ma, "Fuzzy C-Means Clustering With Local Information and Kernel Metric for Image Segmentation", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL-22, NO.2,FEBRUARY-2013.

[12] S. Rane, G. Sapiro, and M. Bertalmio. Structure and texture filling-in of missing image blocks in wireless transmission and compression applications. In *IEEE. Trans. Image Processing*, 2002. to appear.

