

# Otsu and Double-Dimensional Clustering With Wingsuit Flying Search Algorithm (WFSA) For Multi-Level Thresholding In Image Segmentation

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Received on: 29 March,2023

Revised on: 21, April,2023

Published on:23 April,2023

**Abstract** – In recent years image segmentation plays very vital and important role in branch of computer vision. This process of segmentation is divides pixels of particular image into the groups related to image.here in this proposed algorithm we use another segmentation method which based on Otsu and Double-Dimensional Clustering with Wingsuit Flying Search Algorithm (WFSA) for multi-level thresholding in image segmentation (ODDC-WFSA-MTIS) is proposed. this algorithm having fast multilevel segmentation method as compared to other.

Segmentation needs threshold level to separate the object from the background to read the image properly and identify meaningful content of an image. In this era it has found more attention of researchers. Thresholding is a process, used to split the image pixels in to different group/cluster by comparing the intensity value of image pixels with reference threshold level. The threshold value split the image pixels in a way that pixels having lower intensity-value than fixed threshold level belongs to one cluster while pixels whose intensity-value is more than fixed threshold level belongs to another cluster. Image segmentation method is useul for face recognition, medical image processing image analysis, object detection. In our proposed algorithm we have study about the thresholding technique of image segmentation and implemented in Wingsuit Flying Search Algorithm (WFSA) is used to optimize threshold, and then uses this thresholding value to segment the image.

**Keywords-** Wingsuit, Flying Search Algorithm (WFSA), Otsu and Double-Dimensional Clustering.

## I. INTRODUCTION

Image segmentation is widely use as part for new researcher because there is many problems behind this process [1]. This method of segmentation is very effective and easy with the problem related with image resolution [2]. Multilevel image Thresholding is important in real time pattern recognition and image processing based applications [3]. It identifies pixels quickly and effectively in different groups indicating multiple regions in an image. Segmentation of images based on thresholding by using various intelligent optimization techniques with fuzzy entropy is widely utilized for defining thresholds in a better way to use them precisely [4]. Segmentation related with digital image is process for analysis of image to feature extractions [5].

Segmentation is a method or process of portioning image into numerous regions or clusters separated by gray values, which related to various real-world objects in the image. The thresholding method of segmentation is one such most important and efficient technique for

digital image segmentation, various types of techniques aim for segmentation [6-8]. There are many properties with thresholding techniques like the require lesser storage space, processing speed, leading to consideration for effective image segmentation for numerous applications [9]. Since image segmentation with multilevel thresholding is a well-developed field in image processing. Thresholding techniques are mainly divided into two types (i) bi-level and (ii) multilevel thresholding depends on thresholding levels computed on the gray level range [10-11].

In the bi-level thresholding method, an image is segmented into two regions based on the threshold level. Single or Multilevel thresholding is an effective approach for image segmentation [12-13]. In bi-level thresholding which selects only one threshold and separates the pixels into two classes, while multilevel thresholding determines multiple thresholds which divide the pixels into several groups [14]. However, the determination of threshold to segment the histogram of image is a non-trivial issue meanwhile more often than time; that curve of histogram can be difficult to segment because of ambiguities [15].

## II. LITERATURE REVIEW

Among the numerous research works related to multilevel thresholding, some of the most recent research works are reviewed here in this section.

In 2021, Kalyani, R et.al., [16] presented Exchange Market Algorithm (EMA) related to non-parametric objective functions such as Tsallis and Renyi for image segmentation in which attaining accurate with ideal threshold values. The non-additive property of Tsallis and entropic threshold selection property of Renyi drive to search the global threshold value precisely. Highest the segmentation level more is the computational time for exploration of optimal threshold with Tsallis and Renyi. The powerful metaheuristic EMA technique was presented for image segmentation, which implements the strategies of shareholders in stable and unstable mode to earn profit. It provide standard results in stability, computational efficiency, Peak Signal to Noise Ratio (PSNR), uniformity measure and Wilcoxon rank sum test affirm the Tsallis and Renyi based EMA surpass the existing techniques to analyse the real-world images.

In 2021, Houssein, E.H., et.al., [17] had work on Black Widow Optimization (BWO) to find and observe the best threshold configuration using Otsu or Kapur as

objective function. The techniques related with Otsu's between class variance or Kapur's entropy helps to find the best thresholds but computationally expensive for more than two thresholds. The experimental results have revealed that the proposed BWO-based method outperform the competitor algorithms in terms of the fitness values as well as the others performance measures such as PSNR, SSIM and FSIM. The statistical analysis manifests that the BWO-based method achieves efficient and reliable results in comparison with the other methods.

In 2021, Upadhyay, P. and Chhabra, J.K., [18] study about the new multistage hybrid optimization algorithm for Multilevel thresholding based image segmentation. In this Kapur's entropy was used to solve the optimal threshold selection problem and a multistage hybrid nature-inspired optimization algorithm was used to get the best possible parameters for this objective function. The proposed method has three stages namely: primary stage, booster stage and final stage. Particle swarm optimization (PSO), artificial bee colony optimization (ABC) and ant colony optimization (ACO) used at these stages. Peak signal to noise ratio and Structure Similarity Index are used for qualitative assessment. Wilcoxon p value test, ANOVA test and box plots are used for statistical analysis. The experimental results showed that this method performed better in terms of quality and consistency.

In 2021, Mahajan, S., et.al., [19] have presented Fuzzy Entropy Type II (FE-TII) and marine predators algorithm for Image segmentation using multilevel thresholding. For achieving optimal thresholds of an image, the maximization of entropy is tedious and consumes a lot of time with an increasing number of thresholds. This method of MPA presented is analysed in context with image segmentation, particularly on thresholds with TII-FE. For this main reason, this methodology evaluated using several images along with the distribution of histograms. For analysing the performance efficiency of this methodology, the results are compared with robustness was tested with efficiency of presented technique to multi-level image segmentation, several images are used randomly from datasets.

In 2021, Srikanth, R. and Bikshalu, K [20] had work on energy curve with harmony Search Algorithm for Multilevel thresholding image segmentation. The optimized threshold levels computed with an Optimized technique by maximizing the inter-class variance. This

methods with histograms are incapable to possess spatial details of contextual information for finding optimal threshold levels. Here the Energy Curve is used instead of a histogram with Otsu's method and Harmony Search Algorithm to compute optimized gray levels. The proposed method experimented on several benchmark images, and results compared with various optimization algorithms with histogram by Dunn Index, DB Index, SD Index, mean of fitness and PSNR, comparison clarifies that the presented method was superior to histogram-based methods.

In 2022, Hosny, K.M et.al., [21] have presented chaotic coronavirus optimization algorithm with hybrid fitness function for Multilevel thresholding satellite image segmentation. Here in this work the modified Coronavirus Optimization algorithm used for image segmentation. The chaotic map concept was added to the initialization step of the naive algorithm to increase the diversity of solutions. A hybrid of the two commonly used methods, Otsu's and Kapur's entropy, was applied to form a new fitness function to determine the optimum threshold values. Various evaluation metrics are used to measure the quality of the segmented images such as mean square error, peak signal-to-noise ratio, Structural Similarity Index, Feature Similarity Index, and Normalized Correlation Coefficient.

### III. METHODOLOGY

Thresholding method is a simple and effective tool to isolate objects of interest from the background. Its applications include several classics such as document image analysis and whose goal is to extract printed characters logos, graphical content, or musical scores; it is applicable for map processing which leads to locate lines, legends, and characters. It is useful for scene processing, aiming for object detection and marking. Similarly, it has been employed to quality inspection for materials discarding defective parts.

This Multilevel thresholding is the most popular techniques for image segmentation. Multilevel thresholding outputs a grey scale image in which more details from the original picture can be kept, while binary thresholding can only analyse the image in two colours, consist black and white. There are two major existing problems with the multilevel thresholding technique are first one is a time-consuming approach, i.e., finding appropriate threshold values could take an exceptionally long computation time; and second is defining a proper number of thresholds or levels that will

keep most of the relevant details from the original image is a difficult task [16-21].

All related issue have some solutions need to be put forward to fix this problem. The existing models [16-21] that used to find the optimal threshold value is very time-consuming because of the inefficient formulation between the class variance, which are motivated about this research work.

### IV. RESULT & DISCUSSION

In this proposed work, we consider Otsu and Double-Dimensional Clustering with Wingsuit Flying Search Algorithm (WFSA) for multi-level thresholding in image segmentation (ODDC-WFSA-MTIS) is proposed. The input images are taken from standard benchmark dataset as *Berkeley* Segmentation Dataset [22] for validating and analysis the proposed approach Problems related to this Otsu and Double-Dimensional Clustering [23] is proposed for attaining optimal threshold value of image segmentation. The proposed method considers the multilevel threshold as multi-objective function problem and used the Wingsuit Flying Search Algorithm (WFSA) [24] to solve this problem.

The proposed Wingsuit Flying Search Algorithm (WFSA) is used to optimize threshold, then uses this thresholding value to segment the image. The proposed ODDC-WFSA-MTIS is implemented and the performance metrics like mean square error, peak signal-to-noise ratio, Structural Similarity Index, Feature Similarity Index, and Normalized Correlation Coefficient are calculated and analyze.

At last to identify the effectiveness of the proposed ODDC-WFSA-MTIS approach, the proposed approach is compared with existing methods like Fuzzy Entropy Type II (FE-TII) and marine predators algorithm for multi-level thresholding in image segmentation (FE-TII-MPA-MTIS) [19] and Energy curve with harmony Search Algorithm for multi-level thresholding in image segmentation (EC-HAS-MTIS) [20] respectively.

### V. CONCLUSION

In this proposed algorithm Image segmentation using Thresholding algorithms are discussed and analyze. The performance of the ODDC-WFSA-MTIS based multilevel thresholding for image segmentation have been tested with standard images and computed the processing time to determine the optimal thresholding, the results are also compared with the other bio-inspired

multilevel thresholding methods. ODDC-WFSA-MTIS based multilevel thresholding observed to be faster than the existing bio-inspired techniques for image segmentation. The image segmentation and threshold values results of ODDC-WFSA-MTIS algorithm for multilevel thresholding are promising and hence the proposed method can be very useful for multilevel image segmentation problem.

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