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Short Communication

Image Segmentation and Optimization Techniques: A Short Overview

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Segmentation aims to distinguish many essential parts that define objects. Segmentation, a challenging step in image processing, plays a key role in detecting objects and pattern recognition [1]. It is necessary to develop an image segmentation algorithm that does not require human intervention and minimal computational resources. The solution to the problem previously proposed relies on C and K-means clustering algorithms [2-3]. But the cluster number computation was its key drawback, along with the fact that the system's computing complexity increased exponentially.

Furthermore, histogram-based thresholding has provided the solution to the image segmentation, where the number of thresholds (*th*) and histograms would be used together with the objective function. The two broadly employed objective functions proposed presently are the Kapur criteria for entropy [4] and Otsu class variance [5]. The above-stated methods are useful but also increase the computational cost when used with multi-level thresholding. Various methods of optimization have been used by researchers from time to time to solve this problem.

Firefly Optimization Algorithm (FOA) was developed to address the drawback of Kanpur entropy. This approach recreates the behavior of fireflies and bioluminescent interaction processes in nature [6]. Horng also recommended the use of honey bee mating optimization (HBO) in multi-level image thresholds with Kapur's Entropy (KE) [7]. The problem of class variance function and the optimization of the entropy criterion in multi-level thresholding was overcome by the Bacterial Foraging Algorithm (BFA) [8-9]. Harmony Search Optimization System (HSO) [10], but Tuba and Brajevic preferred the use of FOA [11] and Cuckoo Search (CS) [12]. The CS system and Kapur entropy segmentation of satellite images were used. Otsu's approach was tested with the firefly algorithm (FA) [13] for multi-level image thresholds. Tuba and Alihodzic [14] used a bat algorithm (BA) with Otsu and Kapur in multi-level image thresholds. Effective results were obtained when the Tsallis, Kapur and Otsu methods were optimized using the modified artificial bee colony system for multi-level thresholding images [14]. Subsequently, multi-level picture thresholding was used for the Gray Wolf Optimization Process (GWO), and the objective function was based on Otsu's class variance method [15] and Kapur's entropy. Animal Migration Optimization (AMA) and Social Spider (SSA) algorithm were used to optimize class variance for thresholding multi-level images using Otsu class variance methods and Kapur entropy [16-17]. Interdependence has been reduced using an Adaptive Balance Optimizer (AEO) with a multi-level threshold [18]. Additional segmentation of images was carried out using the Exchange Market Optimization (EMO) approach with a minimum cross-entropy threshold [19]. Elazizi [20] used a hyper-heuristic approach to threshold multi-level images [21-22] by optimizing class variance to address a meta-heuristic method's drawback. While optimization approaches used so far have been effective with the user-defined threshold value, we have not achieved a completely programmed segmentation method.

When multi-level thresholding is used in conjunction with peak detection, which relies on information in the histogram, so the objective function where the cluster center is the peak value of the histogram and valley is the upper and lower limit of the cluster defined by the level of intensity of histogram, it can be said that the pixel intensity between successive valleys is taken as a cluster in the image [23-24]. Tsai provided methods for detecting peaks in histograms in which Gaussian Kernel smoothing was applied to reduce fluctuating peaks and valleys [25], which are the best methods for discovering two peaks in the image and do not fail to detect more than two peaks.

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