# A MULTILEVEL THRESHOLDING ALGORITHM FOR IMAGE SEGMENTATION BASED ON BARNACLE MATING OPTIMIZATION

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## Abstract

One of the most crucial topics in the study of image segmentation is multilevel thresholding. However, as the number of thresholds rises, the computing cost of multilayer thresholding grows exponentially. This paper proposes a novel multilevel thresholding method based on Barnacles Mating Optimization (BMO) to address this disadvantage. The way that barnacles naturally mate was a major source of inspiration for BMO. This bio-inspired approach is used to solve multilevel thresholding issues by applying Otsu's between-class variance and Kapur's entropy functions to determine the ideal threshold configuration. Using more than one threshold, multilevel thresholding separates pixels of the image into multiple classes that permit the analysis of the objects in the image. The results are compared with those of other methods found in the literature review.

## 1 Introduction

Image segmentation is a process that separates an image into representative regions according to at least one criterion that is shared within each region. The bulk of image segmentation techniques relies on two essential characteristics of intensity values: similarity and discontinuity [1, 2]. The key tactics used in similarity-based approaches include thresholding, region enlarging, region splitting, and merging. Thresholding is the most accurate, simple, and resilient segmentation algorithm known.

Thresholding (TH) is a popular method for converting grey-level images to binary images. Thresholding is a segmentation process that divides pixels into discrete groups based on their intensity level according to one or more threshold values [3]. The most basic approach for segmenting a picture is to use threshold values, which are the intensity levels determined from the picture's colour (for a colour image) or grey-scale image intensities. Typically, threshold settings are chosen by moving the image histogram up and down. In addition to being simple to use, thresholding is trustworthy and can handle noisy images. In contrast, the issue of thresholding has been studied extensively for years to find the ideal threshold value. Meanwhile, multilevel thresholding (MTH) uses several thresholds to divide the pixels into different regions that represent objects contained in the image [4].

Multilevel thresholding image segmentation has received considerable attention in several image processing applications [4 – 7]. However, the process to determine the optimal threshold values is time-consuming when traditional methods were used. Therefore, we need to implement one new method that can find the optimal value. The image's histogram determines the threshold point, each image has its own set of optimum threshold values. The optimum thresholds are those proposed by Otsu [8] and Kapur [9]. A multilevel thresholding strategy based on the barnacle mating optimization (BMO) algorithm is proposed to optimise the Kapur and Otsu objective function. To improve the application and effectiveness of optimal thresholding strategies, the properties of discriminating analysis using the Kapur and Otsu methods are applied.

Barnacles are hermaphroditic, which means they can reproduce both male and female sex. To create new offspring, they must be fertilised by a neighbour. They have long penises that are roughly seven times the length of their bodies to cope with the shifting tides and inactive lifestyles [10]. Barnacle parents are picked at random in BMO to produce new progeny based on the length of the barnacle's penis [11]. In the exploitation and exploration phases, the Hardy-Weinberg principle and the sperm cast condition, respectively, encourage the formation of new offspring. The effectiveness of the proposed BMO is assessed using a set of benchmark multi-dimensional functions for which global and local minima are known. Comparisons with other recent algorithms will be included in this study.

Barnacles Mating Optimizer (BMO) is a new evolutionary technique for solving optimization problems, as described in [11]. BMO was inspired by barnacle mating behaviour in nature. Hermaphroditic microorganisms have existed since