

## **Multiumbral optimal segmentation through a metaheuristic optimization algorithm**

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Received July 28, 2015; Accepted October 27, 2015

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### **Abstract**

Thresholding is a segmentation technique widely used in industrial applications. It is used when there is a clear difference between the objects to be extracted on the merits of the scene. While there are different methods to find a threshold, most of them do not work well when working with images of the real world due to the presence of noise levels histograms or inadequate lighting.

### **Optimal, Segmentation, Metaheuristic, Optimization, Algorithm.**

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**Citation:** MONTOYA-AGUILAR, Merary, CRUZ-DUARTE, Jorge Mario and AVIÑA-CERVANTES, Juan Gabriel. Multiumbral optimal segmentation through a metaheuristic optimization algorithm. ECORFAN Journal-Democratic Republic of Congo 2015, 1-1: 27-31

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## Introduction

Thresholding is a segmentation technique widely used in industrial applications. It is used when there is a clear difference between the objects to be extracted on the merits of the scene. While there are different methods to find a threshold, most of them do not work well when working with images of the real world due to the presence of noise levels histograms or inadequate lighting. By contrast, the method of Otsu is one of the best methods of selecting threshold for real-world images.

On the other hand, the Bat Algorithm (BA) is a metaheuristic algorithm which is inspired by the echolocation behavior of bats, and uses a frequency balance and automatic tuning of exploration and exploitation by controlling loudness and rates pulse emission. The ability of echolocation in bats is fascinating as these can find their prey and distinguish different types of insects even in complete darkness.

## Statement Problem

In the last hundred years many branches of knowledge have been favored with the advent of computer equipment robust and inexpensive. One example is medicine, where it has reduced the mortality rate due to an erroneous clinical diagnosis. Being specific, the digital medical image processing prevents misplaced interpretations by specialized personnel, mostly caused by noise or scanning errors. Among the most interesting medical imaging scans as lie-rays, ultrasound and encefalografías, besides the images of electrophoresis.

Now, one way to prevent these medical problems, is to segment the images as to clarify the relevant information they contain. For this Otsu's method is traditionally used, among others.

However, this strategy does not deeply studied for more than a threshold segmentation. Thus, for each medical image, you must determine the optimal thresholds that result in the best image segmentation.

Therefore, this research intends to conduct a preliminary study of an unconventional method optimization, as an alternative strategy to the traditionally used to find the optimal thresholds in Otsu method for applications in medical imaging.

## Methodology

To carry out this research was carried out the procedure described below. First, we selected, studied and implemented unconventional method optimization, metaheuristic, the virtual bat (or BA, its acronym in English Bat Algorithm). To do a commercial numerical computing platform operating on Microsoft™ Windows 8.1® operating system used. Next, the algorithm performance tests were conducted using standard test functions commonly used in the literature. Then, as the main part of the research problem, the BA method for solving problems of image segmentation test was implemented. Each test was repeated for about 10 times, from a statistical analysis, adjust the control parameters of the method for thresholding problems. An example of these is shown in Figure 1. And the results were compared with those obtained by the method of particle swarm (or PSO, its acronym in English Particle Swarm Optimization).



**Figure 1** Image Standard Test: Lena in (a) color and (b) grayscale. RESULTS