ISSN: 2319-7080 International Journal of Computer Science and Communication Engineering
Volume 2 Issue 1 (February 2013 Issue)

# Investigate the Performance of Bacteria Foraging Optimization on Color Image Quantization of LUV Images

**Guneet Kaur Arora[1], Surbhi Gupta[2]**

[1]M.Tech Scholar, Department of Computer Science & Engineering

[2]Assistant Professor, Department of Computer Science & Engineering

[1, 2] Rayat Institute of Engineering & Information Technology, Railmajra (Punjab), India

[1]aroraguneet87@gmail.com, [2]sunilkhullar222@yahoo.co.in

*Abstract*— **The CIE Luv color space is designed to be perceptually uniform, meaning that a given change in value corresponds roughly to the same perceptual difference over any part of the space. Using such a space for quantizing given step in color value will be noticeable on a display or hardcopy. Bacteria Foraging Optimization a nature-inspired optimization has drawn the attention of researchers because of its efficiency in solving real-world optimization problems arising in several application domains. Color image quantization is an important process of representing true color images using a small number of colors. The objective of this research work is to investigate the performance of Bacteria Foraging Optimization on color image quantization of LUV images. To implement, test the proposed algorithm. To compare the designed algorithm with other quantization techniques.**

*Keywords*— **Color reduction, Bacteria Foraging Optimization, LUV, LUV color difference**.

## I. Introduction

Bacteria Foraging Optimization Algorithm (BFOA), proposed by Passino, is a new comer to the family of nature-inspired optimization algorithms. For over the last five decades, optimization algorithms like Genetic Algorithms (GAs), Evolutionary Programming (EP), Evolutionary Strategies (ES), which draw their inspiration from evolution and natural genetics, have been dominating the realm of optimization algorithms. Recently natural swarm inspired algorithms like Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO) have found their way into this domain and proved their effectiveness. Following the same trend of swarm-based algorithms, Passino proposed the BFOA. Application of group foraging strategy of a swarm of *E.coli* bacteria in multi-optimal function optimization is the key idea of the new algorithm. Bacteria search for nutrients in a manner to maximize energy obtained per unit time. Individual bacterium also communicates with others by sending signals. A bacterium takes foraging decisions after considering two previous factors. The process, in which a bacterium moves by taking small steps while searching for nutrients, is called chemotaxis and key idea of BFOA is mimicking chemotactic movement of virtual bacteria in the problem search space. Since its inception, BFOA has drawn the attention of researchers from diverse fields of knowledge especially due to its biological motivation and graceful structure. Researchers are trying to hybridize BFOA with different other algorithms in order to explore its local and global search properties separately. It has already been applied to many real world problems and proved its effectiveness over many variants of GA and PSO. Mathematical modeling, adaptation, and modification of the algorithm might be a major part of the research on BFOA in future.

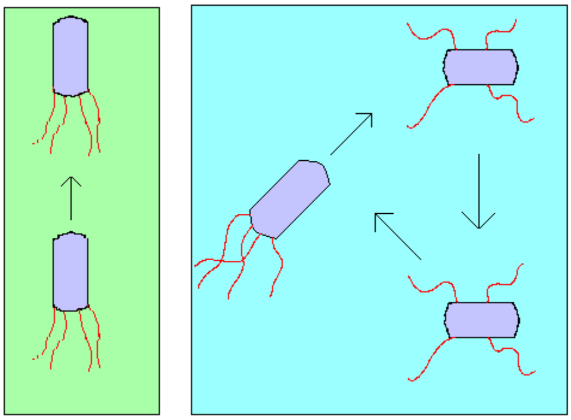


**Fig.1**. Bacteria Movement

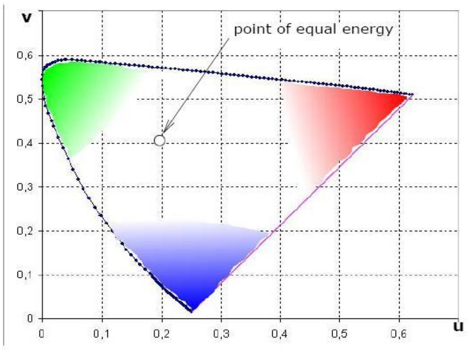
A color image quantization is a process that reduces the number of distinct colors used in an image, usually with the intention that the new image should be as visually similar as possible to the original image. Computer algorithms to perform color quantization on bitmaps have been studied since the 1970s. Color quantization is critical for displaying images with many colors on devices that can only display a limited number of colors, usually due to memory limitations, and enables efficient compression of certain types of images. Color quantization is important because quantized image can be used in many applications including the following.

- It can be used in lossy compression techniques.

- It is suitable for mobile and hand-held devices where memory is usually small.
- It is suitable for low-cost color display and printing devices where only a small number of colors can be displayed or printed simultaneously.
- Most graphics hardware use color lookup tables with a limited number of colors.

So, the main objective of color image quantization is to map the set of colors in the original color image to a much smaller set of colors in the quantized image.

The CIE LUV color models are considered to be perceptually uniform and are referred to as uniform color model. This model is uniform derivations from the standard CIE XYZ space. "Perceptually uniform" means that two colors that are equally distant in the color space are equally distant perceptually. To accomplish this approach, a uniform chromaticity scale (UCS) diagram was proposed by CIE. Lightness scale L that is approximately uniformly spaced but is more indicative of the actual visual differences. Chrominance components are U and V for CIE LUV (referred to also respectively as red/blue and yellow/blue chrominances).This color space model are derived from the CIE XYZ color space.




1.2 **CIE *u',v'* Uniform Chromaticity Scale Diagram**

## II. Related Work

Several heuristic techniques for color image quantization have been proposed in the literature. Some of them are discussed below.

The median cut algorithm (MCA) divides the color space repeatedly along the median into rectangular boxes until the desired number of colors is obtained.

Popularity Algorithm builds the color map by finding the K most frequently appearing colors in the original image. Therefore the colors are stored in a histogram. The K most frequently occurring colors are extracted and they are made the entries in the color table. Now the true image can be quantized.

The variance-based algorithm (VBA) also divides the color space into rectangular boxes. However, in VBA the box with the largest mean squared error between the colors in the box and their mean is split.

The octree quantization algorithm repeatedly subdivides a cube into eight smaller cubes in a tree structure of degree eight. Then adjacent cubes with the least number of pixels are merged. This is repeated until the required number of colors is obtained.

M. G. Omran in his paper proposes Color image quantization based on PSO. The proposed approach is of the class of quantization techniques that performs clustering of the color space. The proposed algorithm randomly initializes each particle in the swarm to contain K centroids (i.e. color triplets). The K-means clustering algorithm is then applied to each particle at a user-specified probability to refine the chosen centroids. Each pixel is then assigned to the cluster with the closest centroid. The PSO is then applied to refine the centroids obtained from the K means algorithm.

## III. Design

**Step 1:** Design an algorithm for color image quantization of LUV images by mimicking the behavior of bacteria as in BFOA.

**Step 2:** Validate the proposed algorithm by running on various types of images.

**Step 3:** Compare the results of previous work with the results generated in step 2.

The performance matrix will comprise of following image quality measures:

1) Mean Square Error.
The large value of MSE means that image is poor quality.
2) Peak Signal to Noise Ratio (PSNR)
The small value of Peak Signal to Noise Ratio (PSNR) means that image is poor quality.
3) Maximum Difference (MD)
The large value of Maximum Difference (MD) means that image is poor quality.

## IV. Conclusion

In this paper, we have presented Bacteria Foraging Optimization algorithm for color image quantization. The BFOCIQ uses the LUV color model. By means of this model you can handle colors regardless of specific devices (such as monitors, printers, or computers). In this research, Including the phantom images. BFO is to be implemented on various types of images. This will validate the proposed algorithm and give optimized results when implemented on the phantom images.

## V. References

**[1]** Bremermann H. J. and Anderson R.W., "An alternative to back- propagation: a simple rule of synaptic modification for neural net training and memory," Tech. Rep. PAM-483, Cent for Pure and Applied Mathematics, University of California, San Diego, Calif, USA, 1990.

**[2]** Chan H., Zhu Y., and Hu K., 2009 " Cooperative Bacterial Foraging Optimization" Hindawi Publishing Corporation Discrete Dynamics in Nature and SocietyVolume2009, Article ID 815247, 17 pages.

**[3]** Dekker A (1994) Kohonen neural networks for optimal color quantization, Network: Computation in Neural Systems 5: 351- 367.

**[4]** Foley J. D., Van Dam A., Feiner S. K., Hughes J. F., Computer Graphics - Principles and Practice, Second Edition, Addison- Wesley Publishing Company, 1990,ISBN 0-201- 12110-7.

**[5]** Freisleben B, Schrader A (1997) An evolutionary approach to color image quantization, Proceedings of IEEE International Conference on Evolutionary Computation, 459-464.

**[6]** Hunter l,a,b verses CIE (1976) L*a*b*(http://www.hunterlab.com/appnotes/an02_01.pdf)(PDF)

**[7]** Hunter labs (1996) " Hunter lab color scale" Insight on color 8 9 (August 1-15, 1996).Reston, VA, USA: Hunter Associates Laboratories

**[8]** Hunter lab Application notes (2008)"Insight on color CMC" Vol 8, No 13

**[9]** Kim D. H. and Cho J. H., "Adaptive tuning of PID controller for multivariable system using bacterial foraging based optimization," in Proceedings of the 3rd International Atlantic Web Intelligence Conference(AWIC '05), vol. 3528 of Lecture Notes in Computer Science, pp. 231–235, Lodz, Poland, June 2005.

**[10]** Kim D. H. and Cho C. H., "Bacterial foraging based neural network fuzzy learning," in Proceedings of the Indian International Conference on Artificial Intelligence, pp. 2030–2036, Pune, India, December2005.

**[11]** Mahamed G. Omran and Andries P. Engelbrecht, AyedSalman "A Color Image Quantization Algorithm Based on Particle Swarm Optimization Informatica (2005)261– 269.

**[12]** Mishra S., "A hybrid least square-fuzzy bacterial foraging strategy for harmonic estimation," IEEE Transactions on Evolutionary Computation, vol. 9, no.1, pp. 61–73, 2005.

**[13]** Passino K. M., "Biomimicry of bacterial foraging for distributed optimization and control," IEEE Control Systems Magazine, vol.22, pp. 52–67, 2002.

**[14]** Rui X, Chang C, Srikanthan T (2002) On the initialization and training methods for Kohonen self organizing feature maps in color image quantization, Proceedings of the First IEEE International Work shop on Electronic Design, Test and Applications.

**[15]** Scheunders P (1997) A genetic C-means clustering algorithm applied to color image quantization, Pattern Recognition 30(6): 859-866.

**[16]** Segenchuk S. "An Overview of Color Quantization Techniques"