

Curvelet Transform and Hybrid Bacterial Foraging Optimization for Image Denoising

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Abstract: Eliminating noise from the original image is still a challenging task for researchers. Several algorithms have been proposed and each of them has its own assumptions, advantages & limitations. The paper proposes the noise reduction method for the medical images by using Hybrid BFO i.e the fusion of BFO (Bacteria foraging optimization) and the technique of contourlet transform and the results are compared with the older technique of image denoising using curvelet transform. BFO algorithm is an artificial intelligence nature-inspired optimization algorithm technique which is based on mimicking the foraging behavior of E.coli bacteria and it is now applied to the field of imagingdenosing.

Keywords: Bacterial foraging algorithm (BFA), Denoise, Tumble, Swim , Magnetic resonance imaging(MRI), Computed tomography.

I. INTRODUCTION

Digital Image Processing is part of digital signal processing. Domain of digital image processing alludes to images with the assistance of digital computer [1]. DIP involves the variation of digital data for improving the qualities of image with the assistance of computer[2]. Digital image is portrayal of a 2D image as a finite set of digital values, known as pixels or picture elements . Digital image comprises of a definite number of rows and columns of pixels. Pixel is a term used to connote the components of a digital image. Input of an image is given to the system and the system is programmed to change the pixels of an image using a series of equations , then values generated using the equation of each pixel in the image is stored . Digital Image Processing has numerous advantages regarding cost, speed and edibility and so forth . It also assists one to improve image features of interest while uprooting subtle elements inconsequential to any application , and then it extracts valuable information concerning region from the enhanced image[2].

Bacteria foraging optimization (BFO)WAS FIRST INTRODUCED BY Passino [1],is a new technique for the family of nature inspired optimization algorithm.

More than five year ago, optimisation algorithm like evolutionary strategies (ES), GENETIC ALGORITHM (gas), EVOLUTIONARY PROGRAMMING (EP), which get their motivation from evolution and natural genetic. Bacteria foraging optimization algorithm design based on the food seeking behavior of E- coli bacteria .It is a best

technique to find out theestimated solution to severe difficult problem The capability and the process of food searching behavior of the bacteria is seen and similarly optimization is done.

II. HYBRID BACTERIAL FORAGING OPTIMIZATION (HBFO)

Hybrid BFO is the fusion of contourlet transform and BFO. SimpleBFO algorithm is nature inspired artificial intelligence technique that is based on the food seeking and reproductive behavior of bacteria E.coli. The food seeking behavior of the bacteria is copied and the similar algorithm is prepared which is later used to denoise the image so that desired image can be made free from noise. During foraging , E- coli bacteria endure four stages , namely, chemotaxis ,swarming , reproduction and elimination and dispersal.

A.Chemotaxis

This method is used for navigating , managing and intaking the food. During foraging a bacterium can display two dissimilar method actions: tumbling or swimming. Biologically, an E-coli bacteria can proceed in two different way, the bacterium can move in its same direction or it may tumble.[11] Chemotaxis movement sustained until a bacterium move in the path of positive nutrient gradient. After completion of swim, the best half of the population undertake the reproduction, removing the remaining population.

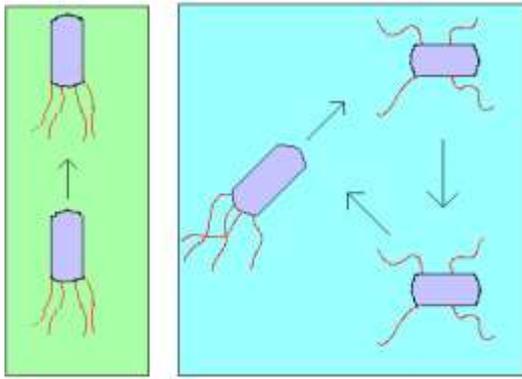


Figure 1. Swim and Tumble of Bacterium

B. Reproduction

In this method the bacteria which are least healthier eventually die which each of the healthier bacteria asexually divide into two bacteria, which are then positioned in the same location. This keeps the size of swarm stable.[9].

C. Elimination and dispersal:

Rapid change in the nearby environment where the bacterium might sustain due to various causes e.g. large amount bacteria may kill due to hike in temperature that are presently in a region with the high intensity of nutrients gradients. Events can happen in such a way that all bacteria in a particular region may destroy or a group is disassemble into a new environment.

Let us define a chemotactic step to be a tumble followed by a run or a run followed by a tumble [12].

III. CONTOURLET TRANSFORM

Method is basically used to enhance the sharpness by highlighting the edges may thus contribute to enhance the quality of image. In order to get smooth contours of images, it uses a double filter bank structure.

The Parameters comparison along with the images of curvelet and hybrid BFO algorithm are discussed now along with the figures.



Figure 3 Noisy Image taken as a sample image.



Figure4:Curveletdenoised image with (SSIM=0.0644, EPI=0.600)

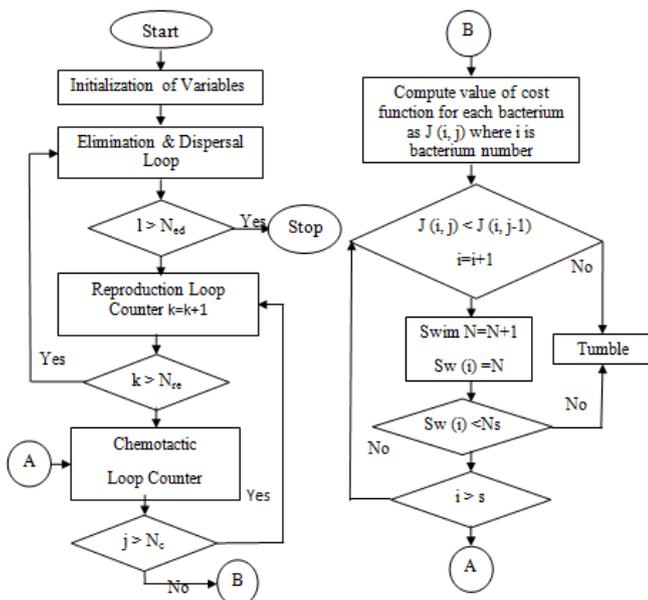


Figure2.Flow Chart of BFO Algorithm



Figure5: Hybrid BFO Denoised image (result of our method with SSIM=0.289, EPI=0.793)

SSIM	EPI
0.0644231	0.600388
0.289022	0.793654

Figure6:Parameters comparison shown between the CurveletDenoising and proposed technique Hybrid BFO.

CONCLUSION

This paper clearly describes the two methods, the old one i.e.curvelet transform and the new proposed technique of hybrid BFO i.e BFO fusion with the contourlet transform . In the curvelet transform ,the double filter bank structure is used and a correlation Analysis is performed. In the proposed technique the study of behavior of bacteria e.coli for its food seeking is done and the same procedure is optimized in coding of the matlab and then the contourlet transform is applied to the result. Bacterial Forging Optimization Algorithm is simple and easy to implement. Fusion of BFO with contourlet has generated remarkable results. Along with noise,the edges of an image are also being enhanced. The result of both the techniques are compared and as HBFO algorithm works pixel to pixel hence improving the noise more accurately in terms of performance taking into measures such as the parameters

SSIM and EPI were improved. From the literature analysis,it is inferred that the results of the HBFO nature inspired artificial intelligence technique is very positive and are much improved than the Curvelet Transform Denoising.

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