ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Intelligent Optimization Techniques based Multimodal Image Fusion for Brain Tumor Detection.

SL Jany Shabu[1]*, and C Jayakumar[2].

[1]Department of Computer Science & Engineering, Sathyabama Institute of Science and Technology, Chennai, India.
[2]Professor, Department of Computer Science & Engineering, Sri Vekateswara College of Engineering, Sriperumbudur, India-602117.

ABSTRACT

Brain tumors can directly destroy all healthy brain cells, so it is very important to detect the brain tumor with good accuracy for that we are using image fusion.Image fusion is a challenging area and fusion is limited to only combining any two types of images, The proposed work aims in fusing multimodal images, multimodal images are images from different sensors that is CT, MRI, PET, and SPECT. Multimodal image fusion is the technique of combining multiple images of the same scene. The information from the input images are extracted and combined in an effective manner to produce the fused image. The proposed work preserves significant features which are usually lost in the native techniques of obtaining images from different sensors.In order to carryout image fusion various algorithm are being developed to provide good result. Various Optimization Algorithms such as ABC, GA,Fuzzy etc are being explored to enhance the image contents after image fusion is applied on the set of data.In this research paper information set of the data taken from optical sensor and image fusion is applied to achieve better set image with the help of Artificial Bee Colony and Genetic Algorithm based image fusion. Also the effectiveness of these techniques are evaluated on the basis of PSNR values.

Keywords: Computer Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography(PET), Genetic Algorithm, Artificial Bee colony optimization, Entropy, Peak Signal to Noise Ratio (PSNR), Root Mean Square Error (RMSE).

Corresponding author

ISSN: 0975-8585

INTRODUCTION

In the current scenario, one of the common fatality causes is the errors that occur during the detection of a brain tumor. In this case, image fusion can be used to find out the abnormal tumor portion in the brain accurately. A brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, due to unregulated mechanisms that control cells. Several techniques have been developed for the detection of a tumor in the brain.

ARTIFICIAL BEE COLONY OPTIMIZATION

Artificial Bee Colony Algorithm (ABC) is a swarm intelligence based optimization algorithm for numerical minimization problems. Basic steps of the algorithm are given below:

- Initial food sources which represent possible solutions are produced for all employed bees.
- Following steps are repeated until the requirements are met:
    - Each employed bee goes to a food source and determines a neighbor source, then evaluates its nectar amount (quality of the solution).
    - Each onlooker bee watches the employed bees and chooses one. After choosing a neighbor around that chosen source, the nectar amount is evaluated as well.
    - Some food sources are abandoned, and they are replaced with the new food sources discovered by scout bees.
    - The best food source found so far is memorized.

In the algorithm, the position of a food source represents a possible solution to the problem, and the nectar amount of a food source corresponds to the quality (fitness) of that solution. The number of solutions is equal to the number of the employed bees in the population. At step 1, uniformly distributed random initial population (food source positions) is generated. In step 2, the population is evaluated to repeat the cycles of the search processes of the employed, onlooker, and scout bees, respectively. An onlooker bee chooses a food source (*i*) with the probability of the following equation:If the nectar amount of the new source is higher than that of the previous one, new source position is memorized. After all employed bees complete the search process, the position information of the sources is shared with the onlookers. Onlooker bees evaluate the nectar information taken from employed bees and choose a food source depending on the nectar amounts of sources. Some sources, which is determined by the limit parameter, are abandoned, and newsources are produced randomly by scout bees.

The main steps of the algorithm are given below:

- Initialization
- Repeat
    - Assign the employed bees onto the food sources in the memory;
    - Place the onlooker bees on the food sources in the memory;
    - Send the scouts to the search area for discovering new food sources.
- Until (requirements are met)

ARTIFICIAL BEE COLONY OPTIMIZATION IN IMAGE FUSION

The objective of the study is to apply the ABC algorithm for fusion of multimodal images.Multimodal images are the images coming from different sensors.In our experiment, the initialization phase consists of assigning a source to the employed bees, i.e. we are reading two images. Since the work is on the fusion of two images, each of these images is divided into small areas which become the source for employed bees, i.e. we are dividing images into a small window. As we are interested only in the information contained in the individual images taken at different time intervals, we have chosen entropy as the nectar, and the entropy value is the measure of the nectar amount, i.e. entropy of each corresponding window of two images is calculated. The onlooker bees compare these values and they choose the pixel of the image from the source which has the highest nectar amount and put them into the hive (fused image), i.e. entropy value of the

corresponding windows of two images are compared with each other, the window having highest entropy value is chosen for output images. Further, the center pixel of the window is chosen for the output image

Steps for ABC Algorithm

Initialization phase:
Read two images(Source).
Employed Bee phase:
Select a source area of size (m x m) in both the images.
Calculate the properties(nectar amount) for both the source area.
Onlooker Bee phase:
Select the center pixel(nectar) of the source area(source) having highest property value (nectar value).
Store the selected pixel in 2D buffer(hive).
Scout Bee phase:
Select next source area (new source) and repeat the steps 3 to 5, (p-m/2)*(q- m/2) times.
Here, p= Height and q = width of the selected image and w=window size.

GENETIC ALGORITHM

A variety of algorithms have been evolved from nature. A genetic algorithm is one of the simplest and most popular evolutionary algorithms.. GA makes use of the simplest representation, reproduction, and diversity mechanism. Optimization with GA is performed through a natural exchange of genetic material between parents. Offspring are formed from parent genes. The fitness of offspring is evaluated. The fittest individuals are allowed to breed only.

GA Cycle

Choose an initial population

- Evaluate the fitness of each individual in the population
- Repeat
- Select best-ranking individuals to reproduce a new population
- Breed new generation through crossover and mutation to give birth to offspring
- Evaluate the individual fitness of the offspring
- Replace worst ranked part of the population with offspring
- Until some termination condition is met

GENETIC ALGORITM IN IMAGE FUSION

The GA is a stochastic investigation technique which boosts the natural choice procedure.

A typical genetic algorithm requires:

1. A genetic representation of the solution domain,
2. A fitness function to evaluate the solution domain.

The algorithm is started with a set of solutions (represented by chromosomes) called population. Solutions from one population are taken and used to form a new population. This is motivated by hope, that the new population will be better than the old one. Solutions which are selected to form new solutions (offspring) are selected according to their fitness - the more suitable they are, the more chances they have to reproduce.

Steps for Genetic Algorithm

1. **[Start]** Generate a random population of *n* chromosomes.

2. **[Fitness]** Evaluate the fitness of each chromosome in the population
3. **[New population]** Create a new population by repeating the following steps until the new population is complete
    - **[Selection]** Select two parent chromosomes from a population according to their fitness.
    - **[Crossover]** With a crossover probability cross over the parents to form a new offspring (children). If no crossover was performed, offspring is an exact copy of parents.
    - **[Mutation]** With a mutation probability mutate new offspring at each locus.
    - **[Accepting]** Place new offspring in a new population
4. **[Replace]** Use newly generated population for a further run of the algorithm
5. **[Test]** If the end condition is satisfied, **stop**, and return the best solution in the current population
6. Go to step **2**

S

PERFORMANCE EVALUATION & RESULTS

Evaluation measures are used to evaluate the quality of the fused image. The fused images are evaluated, considering the following parameters:

The entropy of an image is a measure of information content. It is the average number of bits needed to quantize the intensities in the image. It is defined as:

$$E=-\sum_{i=1}^{N}(p(x_i)\ln(x_i)$$

The root means square error (RMSE) measures the amount of change per pixel due to the processing. The RMSE between a reference image R and the fused image F is given by

$$RMSE = \frac{1}{MN}\sum\Sigma\left(F1(i,j)-F2(i,j)\right)^2$$

Peak signal to noise ratio (PSNR) can be calculated by using the formula

$$PSNR = 10\log_{10}(255/(\sqrt{MSE}))^2$$

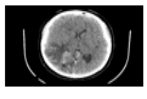
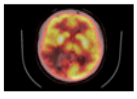
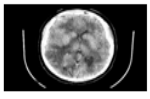
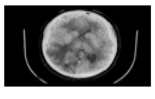
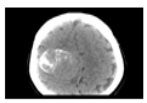
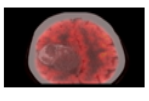
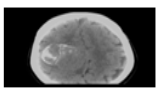
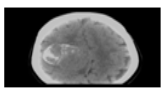
Dataset	CT	PET	GA Based Fused Image	ABC Based Fused Image
Patent1				
Patent2				

Fig 1:GA and ABC Based Fused Image

ISSN: 0975-8585

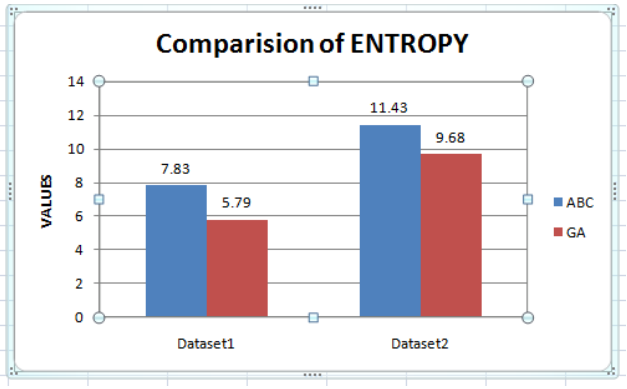


Fig 2:Comparision of Entropy between GA &ABC

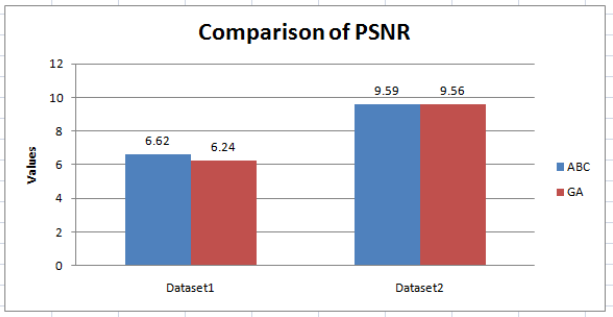


Fig3:Comparision of PSNR between GA &ABC

CONCLUSION

Medical image fusion of two different modalities is performed using the ABC and GeneticAlgorithm. A comparative study is performed on image fusion by implementing the ABC and Genetic Algorithm.In our research work, we have effectively concluded that the ABC algorithm has more information content (higher Entropy value) and also looks better than the images fused by Genetic Algorithm.A large number of artifacts were observed by subjective analysis in the images which were fused using a smaller source area than those of larger source areas [1-12].

REFERENCES

[1] Anu Priya S, RajaKumari K, "Multimodality Brain Tumor Image Fusion Using Wavelet and Contourlet Transformation", International Journal of Data Mining Techniques and Applications Volume 04, Issue 01, June 2015.

[2] Ambily P.K., Remya R.Mohan, Shine P.James, "Brain Tumor Detection using Image Fusion and Neural Network", International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015

[3] CYN Dwith,Vivek Angoth, Amarjot Singh," Wavelet Based Image Fusion for Detection of Brain Tumor",*I.J. Image, Graphics and Signal Processing,2013.*

[4] D.Jagadish,K.Sindhu "Detection of Brain Tumor by image Fusion Based on Discrete Wavelet Transform", Journal *of* Chemical and Pharmaceutical Sciences, ISSN 0974 – 2115 Volume 6, Issue 6, March 2017.

[5] S.L.Jany Shabu,Dr.C.JayaKumar," Multimodal Image Fusion using An Evolutionary based algorithm for Brain Tumor Detection", Biomedical Research",2018,Volume 29,Issue 14,ISSN 0970 -938X.

[6] Lakhwinder Singh, Dr. Sunil Agrawal, Mrs. Preeti Gupta, "Review on Medical Image Fusion Based on Neuro-Fuzzy approach" International Journal of Scientific Research Engineering & Technology (IJSRET), ISSN 2278 – 0882 Volume 4, Issue 7, July 2015.

[7] Manoj Kumar Kathane,Vilas Thakare, "An Intelligent Approach for Automatic brain tumor Detection "International Journal of Engineering and Innovative Technology,Volume 3 ,Issue7,January 2014.

[8] Dr. Pankaj Mohindru, Maninder Singh Gill, Dr. Pooja, "A New Image Fusion Algorithm Based on Wavelet Transform and Adaptive Neuro Fuzzy Logic Approach", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 3, Issue 8, August 2014.

[9] Dr. Pankaj Mohindru, Dr. Pooja , "A New Image Fusion Algorithm Based on Wavelet logic Approach" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 8, August 2014.

[10] K.Pradeep,S.Balabubramanian,Hemalatha karnan "Segmentation of fused CT and MRI Images with Brain Tumor" Asian Journal of Science and Applied Technology(IJSRET), ISSN 2249 – 0698 Volume 6, Issue 1, 2017.

[11] Rajalingam , Dr. R.Priya, Hybrid Multimodality Medical Image Fusion Technique for Feature Enhancement in Medical Diagnosis, International Journal of Engineering Science Invention (IJESI), ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726,2018

[12] M.Sharmila, M.Padma usha, "Brain Image Fusion Via Graph Cut Algorithm", International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN 0976-1353 Volume 13 Issue 4 – MARCH 2015.