G. Anusha* et al.
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.4, Issue No.5, August – September 2016, 3848–3851.

SAR Image Segmentation Using ABC Algorithm

G.ANUSHA
M.Tech Student
Department of ECE
Kamala Institute of Technology & Science
Karimnagar, Telangana, India

GAURI PUNDLIK
Asst. Professor
Department of ECE
Kamala Institute of Technology & Science
Karimnagar, Telangana, India

Abstract: **Conventional methods for segmentation on Synthetic Aperture Radar (SAR) images aim to provide automatic analysis and interpretation of data. Usually the task gets failed at many cases due to the influence of speckle in the segmented results. Due to the presence of speckle noise, segmentation of synthetic aperture radar (SAR) image is still a challenging problem. Artificial Bee Colony algorithm using fitness function. This paper proposes a fast SAR image segmentation method based on Artificial Bee Colony (ABC) algorithm. In this method, threshold estimation is regarded as a search procedure that searches for an appropriate value in a continuous grayscale interval. Hence, ABC algorithm is introduced to search for the optimal threshold. In order to get an efficient fitness function for ABC algorithm, after the definition of grey number in Grey theory, the original image is decomposed by discrete wavelet transform. Then, a filtered image is produced by performing a noise reduction to the approximation image reconstructed with low-frequency coefficients. At the same time, a gradient image is reconstructed with some high-frequency coefficients. A co-occurrence matrix based on the filtered image and the gradient image is therefore constructed, and improved two-dimensional grey entropy is defined to serve as the fitness function of ABC algorithm.**

Keywords: **SAR Images; Image Segmentation; Grey Entropy; Discrete Wavelet Transform; ABC Algorithm;**

I. INTRODUCTION

Image segmentation plays a very important role in the interpretation and understanding of SAR images. It has received an increasing amount of attention and therefore hundreds of approaches have been proposed over the last few decades . Different from optical images, SAR images are inherently contaminated by speckle noise, which inevitably deteriorates the performance of segmentation. Approaches with good performance are often involved in complex computation which may lead the whole process to be more expensive in terms of time. So it is still an urgent task to devise simple and efficient methods.

Generally, existing segmentation approaches dealing with SAR images can be divided into two categories: segmentation based on texture and segmentation based on grey levels. The former partitions an image into several homogeneous regions with respect to specific textures. However it is often difficult to determine an exact discrimination for a texture field as well as the number of segmentation areas, especially when the image contains similar texture fields. The latter divides an image into several regions by some thresholds. Hence, an issue of segmentation in this case is a threshold estimation problem . Currently, there are five classes of widely used estimation methods, namely, image statistic methods, between class variance methods, entropy methods, moment preserving methods and quadtree methods. This paper aims at the segmentation based on grey levels, and moreover proposes a new entropy method for SAR images.

II. SYSTEM DESIGN MODEL

In proposed method, the SAR image segmentation is done by employing ABC algorithm. In this method, threshold estimation is regarded as a search procedure that searches for an appropriate value in a continuous grayscale interval. Hence, ABC algorithm is introduced to search for the optimal threshold. The block diagram of proposed method is represented in Fig. 1.

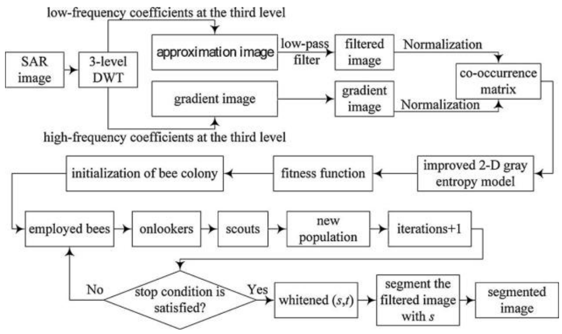


Fig. 1: Block diagram of SAR image segmenatation using ABC algorithm

2.1 ABC algorithm

As a kind of social insects, honey bees live in colonies and exhibit many features. These features include bee foraging, bee dance, queen bee, task selection, collective decision making, nest site selection, mating, pheromone laying and navigation systems, which can be used as models for intelligent applications. Actually, a lot of researchers have been inspired to develop algorithms by the behaviors of bees. A survey of the algorithms based on the intelligence in bee swarms and their applications has been presented.

In ABC algorithm, an artificial bee colony consists of employed bees, onlookers and scouts. A bee waiting on the dance area to obtain the information about food sources is called an onlooker, a bee going to the food source is named as an employed bee, and a bee carrying out random search is called a scout. The position of a food source denotes a possible solution to the optimization problem, and the nectar amount of a food source represents the quality of the associated solution. Initially, a randomly distributed population is generated. For every food source, there is only one employed bee. So the number of employed bees is equal to the number of food sources. Thereafter, the positions (solutions) will be updated repeatedly with the following cycles until the maximum iteration is reached or stop conditions are satisfied. Each employed bee always remembers its previous best position, and produces a new position within its neighborhood in its memory. According to the greedy criterion, the employed bee updates its food source. In other words, when the new food source is better, the old food source position is updated with the new one. After all employed bees finish their search process, they share the information about the direction and distance to food sources and the nectar amounts with onlookers via a so-called waggle dance in the dancing area. By the observation on the waggle dance, each onlooker chooses a food source depending on the probability value associated with the food source, and searches the area within its neighborhood to generate a new candidate solution. And then, the greedy criterion is applied again just as it works in the employed bees. If a position cannot be improved after a predetermined number of cycles, the position should be abandoned; meanwhile, the corresponding employed bee becomes a scout. The abandoned position will be replaced with a new randomly generated food source.

$$P_i = \frac{fit_i}{\sum_{i=1}^{n} fit_i} \quad (1)$$

$$fit_i = \begin{cases} \frac{1}{1+f_i}, & \text{if } f_i \geq 0 \\ 1 + abs(f_i), & \text{if } f_i < 0 \end{cases} \quad (2)$$

III. IMPROVED TWO-DIMENSIONAL GREY ENTROPY

3.1. Grey number in Grey theory

Grey theory, developed by Deng in 1982, is an effective mathematical means of resolving problems containing uncertainty and indetermination [2]. This multidisciplinary and generic theory deals with systems containing poor information. Now, fields covered by Grey theory include society, economics, finance, agriculture, industry, mechanics, meteorology, ecology, hydrology, geology, medicine, etc.

In Grey theory, a random variable is regarded as a grey number, and a random process is treated as a grey process within a certain range. A grey system is defined as a system containing information presented as grey numbers. Here, we only give some simple conceptions used in our segmentation method.

3.2 Image segmentation:

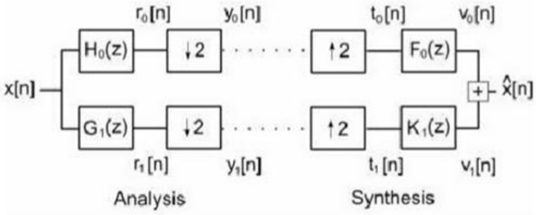
In this section, a method for segmenting the object from the SAR image is proposed. Image segmentation is a technique for extracting information from an image. This is generally the first step in image analysis. Segmentation subdivides an image into its constituent parts or objects. The level to which this subdivision is carried depends on the problem being solved. The image segmentation in this study is performed using ABC algorithm.

IV. SAR IMAGE SEGMENTATION BASED ON ABC ALGORITHM

As far as SAR image segmentation is concerned, the global threshold estimation can be regarded as a search procedure which searches for a proper integer in a continuous integer interval [0, 255]. Hence, it is feasible to apply ABC algorithm to find the optimal threshold. Due to the special imaging mechanism, SAR image contains serious speckle noise, so it is required that the segmentation algorithm is robust to noise pollution.

Steps

(1)Decompose the original image with a three-level DWT. Then low-frequency coefficients at the third level reflecting the approximation information are reconstructed as an approximation image, while high-frequency parts at the third level possessing information on edge and texture are reconstructed as a gradient image.



Wavelet analysis

(2) Employ a low-pass filter (a circular averaging filter) to deal with the approximation image and obtain a filtered image.

(3) Normalize the gradient image I and the filtered image G to [0, 255] by the formulas (3) and (4). After that, construct a 256 × 256 filtered-gradient co-occurrence matrix C to get the improved two-dimensional grey entropy.

$$I(m,n) = \text{round}\left(abs\left(\frac{I(m,n)}{\max\limits_{\forall m,n}(I(m,n))} \times (L-1)\right)\right) \qquad (3)$$

$$G(m,n) = \text{round}\left(abs\left(\frac{G(m,n)}{\max\limits_{\forall m,n}(G(m,n))} \times (L'-1)\right)\right) \qquad (4)$$

(4) Treat the two-dimensional grey entropy as the fitness function of ABC algorithm, and set the control parameters in ABC algorithm, including the population size, the limit times for abandonment, the maximum number of iterations, etc.

(5) By the cooperation and information-sharing of multiple cycles of employed bees, onlookers and scouts, the best bee gradually approaches to the optimal threshold, and at the same time the grey numbers (s, t) are whitened.

(6) Segment the filtered image I with the optimal threshold s and get the final segmented image.

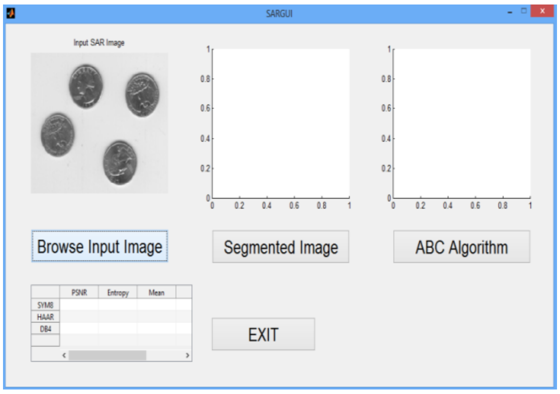
V. CONCLUSION

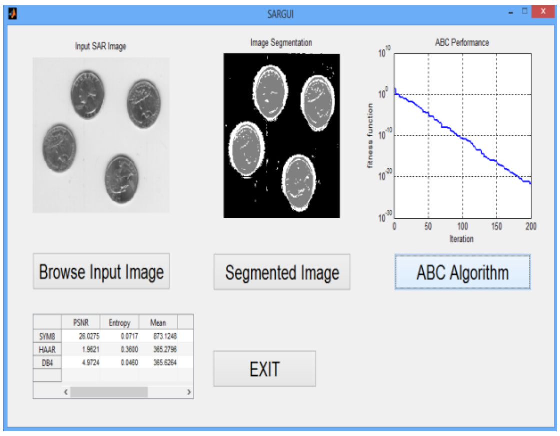
In this paper, we propose a fast segmentation method for SAR images. The method regards threshold estimation as a search process and employs ABC algorithm to optimize it. In order to provide ABC algorithm with an efficient fitness function, we integrate the concept of grey number in Grey theory, multilevel DWT, low-pass filtering and maximum conditional entropy to get improved two-dimensional grey entropy. In essence, the fast segmentation speed of our method owes to ABC algorithm, which has an outstanding convergence performance.

However, as a new heuristic model in swarm intelligence, sophisticated relationships of bees and various foraging possibilities make ABC algorithm go a long way before it becomes mature. For example, ABC algorithm is still weak in mathematics. As for image segmentation discussed in this study, little evidence in theory may be referred to and some control parameters have to be specified by experiences. We would like to point out that, like all global thresholding techniques, the proposed method using a single threshold merely partitions the entire image into two kinds of regions, objects and backgrounds, which is suitable for simple SAR images. The contribution of this paper is to demonstrate and confirm the feasibility of ABC-based image segmentation, and offers a new option to the conventional methods with the merit of simplicity and efficiency. With the efforts of researchers at home and abroad, it is hoped that ABC algorithm will be widely used like GA and PSO in the future.

VI. SIMULATION RESULTS

The total consuming time of our method is composed of two parts. The first part is spent on steps (1)–(3) in Section 4, which includes the time to wavelet decompose, wavelet reconstruct, do the low-pass filtering, and construct the filtered-gradient co-occurrence matrix. So the spent time is in proportion to the image size. The second part is spent after the co-occurrence matrix is created. So the consuming time is independent of the image size, since the searching space of ABC algorithm is always [0, 255] and the computation amount of the fitness function is invariable. In this part, the consuming time is in proportion to the population size and the maximum iteration of ABC algorithm. At the same time, it is also relevant to other parameters of ABC algorithm, such as stop conditions, the limit times for abandonment, and initial distribution of population.





VII. REFERENCES

[1]. P. Marrow, Nature-inspired computing technology and applications, BT Technology Journal 18 (4) (2000) 13–23.

[2]. Y.Q. Wang, W.Y. Liu, Application of swarm intelligence in image processing,

Computer Applications 27 (7) (2007) 1647–1650.

[3]. El Zaart, D. Ziou, S. Wang, Q. Jiang, Segmentation of SAR images, Pattern Recognition 35 (3) (2002) 713–724.

[4]. S.Q. Han, L. Wang, A survey of threshold methods for image segmentation, Systems Engineering and Electronics 24 (6) (2002) 91–94, 102.

[5]. P.K. Sahoo, S. Soltani, A.K.C. Wong, A survey of thresholding technique, Computer Vision Graphics Image Process 41 (2) (1988) 233–260.

[6]. S.U. Lee, S.Y. Chung, R.H. Park, A comparative performance study of several global thresholding techniques for segmentation, Computer Vision Graphics Image Process 52 (2) (1990) 171–190.

[7]. P. Marrow, Nature-inspired computing technology and applications, BT Technology Journal 18 (4) (2000) 13–23.

[8]. Y.Q. Wang, W.Y. Liu, Application of swarm intelligence in image processing, Computer Applications 27 (7) (2007) 1647–1650.

[9]. Y. Tian, W.Q. Yuan, Application of the genetic algorithm in image processing, Journal of Image and Graphics 12 (3) (2007) 389–396.

[10]. C.C. Lai, D.C. Tseng, A hybrid approach using Gaussian smoothing and genetic algorithm for multilevel thresholding, International Journal of Hybrid Intelli-gent Systems 1 (3) (2004) 143–152.

[11]. A. Mishraa, P.K. Dutta, M.K. Ghoshc, A GA based approach for boundary detec-tion of left ventricle with echocardio graphic image sequences, Image and Vision Computing 21 (11) (2003) 967–976.

