An Investigation of Update Information Equations by using the Artificial Bee Colony Method for Skin Cancer Detection.

Mohanad Aljanabi[1,3], Javad Rahebi[2], Yasa Ekşioğlu Özok[1]
[1]Department of Electrical and Computer Engineering, Istanbul Altinbas University, Istanbul, Turkey.
[2]Department of Electrical & Electronics Engineering, Turkish Aeronautical Association University, Ankar, Turkey.
[3]Department of Electrical Power Techniques Engineering, Technical College /Al- Mausaib, Al-Furat Al-Awsat Technical University, Iraq.

Summary
In Artificial Bee Colony, the one design coefficient of the improvement problem is updated by artificial bees at the Artificial Bee Colony phases by making use of mutual influence of the bees. This updating increased the slow convergence and thus helped to find the best solution for the algorithm. The convergence was set apart by means of a direct and indirect method, and the Artificial Bee Colony was proposed to be used in the Artificial Bee Colony equations. However, more than one design parameters were taken into consideration in this approach to updating. The updating depended on the orders the scout bees were given to find a better solution position after searching more in this area. By varying the new updated information (numbers of iterations) and training the algorithms of random and direct Artificial Bee Colony, the accuracy of this system was enhanced and the parameters were compared. In this study, we used the formal equations to find new positions, new update information, and an optimal solution for good food and behavior of the bees by using both the direct and random Artificial Bee Colony method used in detecting the diseases in the medical system. The proposed method provides the highest accuracy and specificity in the detection of melanoma of all other art methods. The comparison showed that the direct method was very efficient in solving skin cancer detection and successful in terms of the best solution quality and durability. The Artificial Bee Colony algorithm gives the best results in segmenting (melanoma and benign) skin cancer images.
Keywords:
Swarm intelligence, artificial bee colony algorithm, Direct Artificial Bee Colony, Skin cancer detection.

1. Introduction

Artificial Swarm Intelligence (ASI) is one of the newest and preferred research domains [1]. The ASI can be utilized in the networks of interactions between algorithms and the environment. Swarm Intelligence (SI) is becoming increasingly significant in research fields and new technology, bioinformaticians, the control of tracking moving objects, the classification of medical dataset, telecommunications as well as in solving problems in the real world because the issues that the natural ASI can resolve (dividing work among colleagues (bees), finding food, and cooperative organized bees and structures of nests) [2,3,4,5,6,7]. Figure (1) show the distributions of percentage of the publications according to some algorithms based on the ASIs and its applications [1].Guo et al. designed a new research organization for the three methods where the enhanced algorithm was named a global Artificial Bee Colony(g ABC).The design is a great use in converging property and solving the best fitness solution [8].

Okdem et al [9] used the random ABC i in wireless sensor networks to obtain an optimal solution. Koc et al implemented ABC to solve automated lesion skin cancer detection, performance which distinguishes the diseases(malignant Melanoma and benign states) [10]. The use of ABC method in biomedical system helped to improve biomedical system decision condition [11].

Karaboga focused on the onlooker bees waiting for the position of shared food sources found by the worker bees in the hive. In accordance with the worker bees have shared the information about the position of the food sources, the onlooker bees chose a position of one of the food sources and attempted to enhance of the food source. The ABC algorithm is an iterative algorithm and only one design criterion of the optimum problem is updated by every worker or onlooker bee at every ABC iteration. In addition, the convergence of the algorithm is slowed down when only one design parameter is updated [12].

In order to get over difficulties, Akay and Karaboga[13] changed a control parameter of ABC. Several authors used directional information in the design of each coefficient, and therefore it led to the slowing down of the approximate convergence of the algorithm. The analysis of this method was examined on the well-known functional numerical optimum problems.

Dongli et al. [14] solved optimization problems using three modified versions of ABC and obtained better results. Firstly, the neighborhood structure was altered to solve the updating equation of ABC. Secondly, a new selection equation was used to help the onlooker bees

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select a worker bee. Finally, the two versions of ABC at the first and second stage were combined.

Banharnsakun et al.[15] brought the convergence of the ABC to a global optimum by using the best-so-far choosing for onlooker bees. They tried the performance of their method on the image detection of skin cancer classification and numerical functions.

Liu et al.[16] used a variant of the ABC algorithm, by means of mutual learning. This algorithm a tune between the candidate food source and the current source by selecting a cooperative learning factor.

Another researcher, Gao et al.[17] developed a new update role for the ABC algorithm. The new update role utilized random solutions to obtain the candidate solution Through updating the rules takes over as a crossover operator of GA, and the Fuzzy method to investigate skin cancer detection. The automatic and random ABC algorithm helped to detect the best solution in the maximum fitness values in segmentation images and recognizing whether the skin cancer is Melanoma (Malignant) or not (benign form) [18, 19].

Some parameters play an important role in detecting skin cancer, defined as ABCDE parameters by the total dermoscopy score (TDS)[20]. Figure (2), shows the normal nevi and Melanomas (Benign and Malignant) of skin tumor. These are helpful in presenting people the varieties as a starting point [21].

The level set technique, used with active curve and explained in [22], generates a pattern of the contour. The contour cannot use any border detection function in finishing the developing curvature on the boundary. However, it utilizes a finishing term instead which is supported by Mumford–Shah segmentation methods[23]. Japan Society of Engineering Geology (JSEG) [24] technique, which depends on color quantization and steps of segmentation, was used to detect skin tumor images in [25].The JSEG utilize J-images related with calculations of limited homogeneities at varies levels to evaluate the edges of the border positions in this image [26].

Statistical region merging(SRM)is a color pictures segmentation method used in preparing are growth and merging the procedure with a synthesis cases. Simplicity and enhanced analysis are the major benefits of SRM. However, this technique is noise sensitive and has an unidentified theoretical picture [27].

It is one of the modern methods used to distinguish skin cancer and has a better specificity and more accurate in segmenting lesions region. Pennis and Bloisi processed the results of the images and detected the evolution of the early types of (malignant and benign) skin tumor known as the Artificial Skin Lesion Merging (ASLM method) .

The analysis of melanoma detection for this method produced better results than the previous methods used for a group of 200 dermoscopic images[28].To find the new position we used the formal equations, and to detect the diseases in the medical system, we updated the new information and the optimal solution for good food in addition to using the direct and random ABC method for the behavior of bees.

The comparison showed that the direct method was very efficient in solving the problem of skin cancer detection and that it was successful in finding the best solution quality and durability.

This article is prearranged: Section 2 provides information about to two models of the ABC method equations and a literature review on this method.

Section 3 demonstrates the principles of the proposed methodology and material in the system in order to recognize the skin cancer detection and the effectiveness of the parameters. Experimental Results simulations are discussed in Section4.

The discussion and some relevant conclusions are given in Section 5.

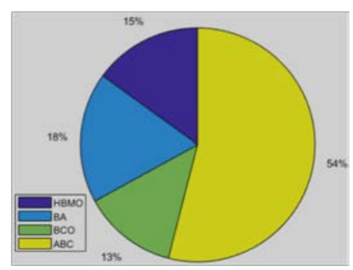

Fig. 1 Percentage of publications of algorithms based on ASIs [1].

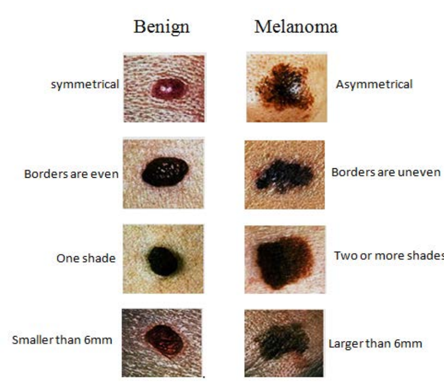

Fig. 2 Standard nevi and Melanomas by ABCDE estimation methods [Benign and Malignant]. Source: www.skinbychar.com [21]

2. The Artificial Bee Colony method equations

Firstly, the worker bees are scout bees in the beginning of the algorithm, and the position a food source is set for every scout bee as shown in the equation below:

$$Z_{i,j} = y_{i,j} + \sigma_{i,j} \cdot (y_{i,j} - y_{k,j}), \mathrm{i} = 1,2, \mathrm{NW}, \mathrm{j} = 1,2,..,\mathrm{D} \ (1)$$

Here $Z_{i,j}$ is the jth dimensions of ith food source, ith being worker bees. $y_{i,j}$ and $y_{k,j}$ is the minimum and maximum bounds of the jth dimension,$\sigma_{i,j}$ is a random number [0,1]. NW is the number of worker bees, and D is the dimensionality of the number of decision variable values of the problem [29]. All the scout bees are worker bees because the scout bees a limited number of food source position for every hive. The following equation shows the values of the food sources of the worker bees (2):-

$$Fit_i = \begin{cases} 1/(1+\mathrm{fi}), if(fi \geq 0) \\ 1+\mathrm{abs}(\mathrm{fi}), if(fi, 0) \end{cases} \ (2)$$

The values of each food source and duration of values for the inhabitance in the algorithm, and the fitness of the ith food source is defined as Fit_i $where\ fi$ is the function values of the optimization problem for a trial counter.

The values of a new food source and almost all the food source found by the worker bees are calculated by means of the following equation (3),

$$y_{i,j} = LB_{i,j} + rand(0,1) \cdot (UB_{i,j} - \mathrm{N}_{i,j}) \ (3)$$

The fitness of the candidate food source is calculated by using equation(2). The randomly chosen dimension of the food source position$UB_{i,j}$ is updated for each the iteration. On the other hand, $y_{i,j}$ represents the position of the candidate food source position. N is the randomly selected neighbor food source in cells $rand(0,1)$ is a random number within the range of $[-1,\ 1]$.Using roulette-wheel selection technique, the fitness of the solution was determined by means of equation(4) so that both the advantages and disadvantages could be compared. A maximum fitness value means that the better values function better. The threshold values function can be obtained to maximize the fitness function as follows:-

$$\mathrm{P_i} = \frac{\mathrm{F_i}}{\sum_{\mathrm{j}=1}^{\mathrm{SR}} \mathrm{F_j}} \ (4)$$

The possibility selection is in fact the roulette wheel selection method, and pi is the probability chosen by the ith worker bee by an onlooker bee. The worker bee memorizes the food source position of the onlooker bee and experiments on this food source are stopped to see whether the fitness of the food source found by the worker bee is better than that of the worker bee or not [30].

The principle of ABC is totally random in terms of direction as $\mathrm{rand}(0,1)$ is a random number between $[-1,$ 1] for guiding around the source food. The undirected searches lows the convergence of the algorithm to the optimum solution. Consequently, we derived equation (3) to find the direction information for each dimension for each food source position. By using the direction information for the dimensions, equation (3) is modified as follows and where r is a random number in the range of [0, 1],dij is the direction information for jth dimension of the ith food source position.

$$y_{i,j} = \begin{cases} LB_{i,j} + \mathrm{rand}(0,1).\ \ \mathrm{if}\ (\mathrm{dij} = 0) \\ LB_{i,j} + \mathrm{r} * \mathrm{abs}(UB_{i,j} - \mathrm{N}_{i,j})\ \mathrm{if}((\mathrm{dij} = 1)\ (5) \\ \mathrm{if}(\ \mathrm{dij} = -1) \end{cases}$$

If the new solution produced by equation (5) is better than the oldest one, then a new solution is found by means of equation (2) considering the fitness values of the old and new solutions in addition to updating the directional information. If the candidate solution of the dimension is less than the current value, the direction information of this dimension is set to -1.In addition, the direction information of the dimension is set to 0 . because the direction information of each dimension of each food source position can be used and the direction direct to ABC of the search ability and convergence rate of the algorithm can be enhanced [31, 32]. As good behavior of ABC is a part of the swarm's intelligence, the particles tend to move with the information that spreads to the swarm. The particle is stimulated to a new location calculated by the velocity that is updated at every time step time T. This new location $\mathrm{X(T+1)}$ is calculate as the sum of the old p location and the new velocity is calculated by equation (6):

$$\mathrm{X(T+1) = X(T) + V(T+1)}\ (6)$$

The velocity update is complete as specified equ (7):

$$\mathrm{V(T+1) = Z\,V(T+1)} + \sigma_{1(i,j)}\mathrm{(P(T) - X(T)} + \sigma_{2(i,j)}\mathrm{(g(t) - X(T))}(7)$$

The factor Z is the inertia weight, controls the magnitude of the old velocity V(t) in the computation of the new velocity, whereas $\sigma_{1(i,j)}$ and $\sigma_{2(i,j)}$ give the significance of P(t) and g(t) respectively[33].Detecting and finding the best food sources influence the survival and of advance the bee colony. In the same way, if more applications of the problems are solved, the better solutions are taken.

3. Methodology and materials

A scout bee discusses the search with lots of previous information, i.e., the new solution is created randomly as specified by equation (1).Thus, so as to verify when a candidate solution has presented the predetermined ‘‘limit,’’ a counter is designed to each food source. Also the bee operation is unsuccessful in improving the food source's fitness by equation (2).

By modifying equation (1),we derive more equations to obtain the best solution position update technique that is evaluated on the feedback information of the algorithm part, from equations(8,9),we get the number of optimal solutions from these equations. The ABC develops a randomly distributed initialization of food source positions, so the maximum fitness is obtained.

Table 1. displays the benefits for utilizing the ABC technique, the information updated to guide the honey bees and the detection of new areas by dance strategy. As shown in the flowchart of Figure (3), the gray scale pictures are more important than more simple color pictures and include a level ranging from 0 to 225. For step of median filter is used to decrease noise in a picture related to other filters. When the ABC phases are deal with, (worker, onlooker and scout) bees to show their behaviour to other bees and guide them to new locations and good food. After optimal solutions, the new images are pressed.

The Methodology proposed aims to find more factors that affect the performance of the analysis image and useful details are shown in this diagram.

$$Z_{i,j} = y_{i,j} + \sigma_{i,j} \cdot \left(y_{i,j} - y_{k,j}\right) + \mathrm{r}\left(y_{best,j} - y_{k,j}\right) \quad (8)$$

$$Z_{i,j} = y_{best,j} + \sigma_{i,j} \cdot \left(y_{i,j} - y_{k,j}\right) \quad (9)$$

Table 1:Advantages of ABC technique.

Usages	***Descriptions***
Simplicity	Easy and straightforward to implement ways.
Flexibility	Improve new algorithms and develop, and flexible enough to modify.
Easy Designing	Having lower parameters, it is easy to design it.
Simple of Combination	It can be easily mixed with other algorithm.
Control parameters	Lower control parameters reduces the complexity.
Richness	Obtaining an optimal solution is a good connection with the communication in the behavior nature of the cells.
Randomly Behavior	Based on foraging behavior of the hive.
Easy of analysis	Generated solution are analysis in behavior nature.
Good of update information	Good method to obtain the correct information for scout bees all the time.

3.1 Materials

The PH2 dataset has been performed by the Hospital Pedro Hispano in Matosinhos, Portugal (PH2). The data consists of eight bit (Red –Green-Blue) colors, with a resolution of 768 × 574 pixels and an enlargement twenty times. The two hundred images for different cases of skin tumor such are eighty common moles of skin dyes, eighty non-standard moles of skin dyes, and forty malignant lesions of skin dyes.

The PH2 image of skin tumor including of medical description of all images gives support to medical segmentation of checkup the area and the contents of the ground truth table. The assessment of all factors was designed utilizing as killed dermatologist for the several parameters to be investigated: the manual partition of lesions region, diagnostic performance, and dermoscopic standard[34].

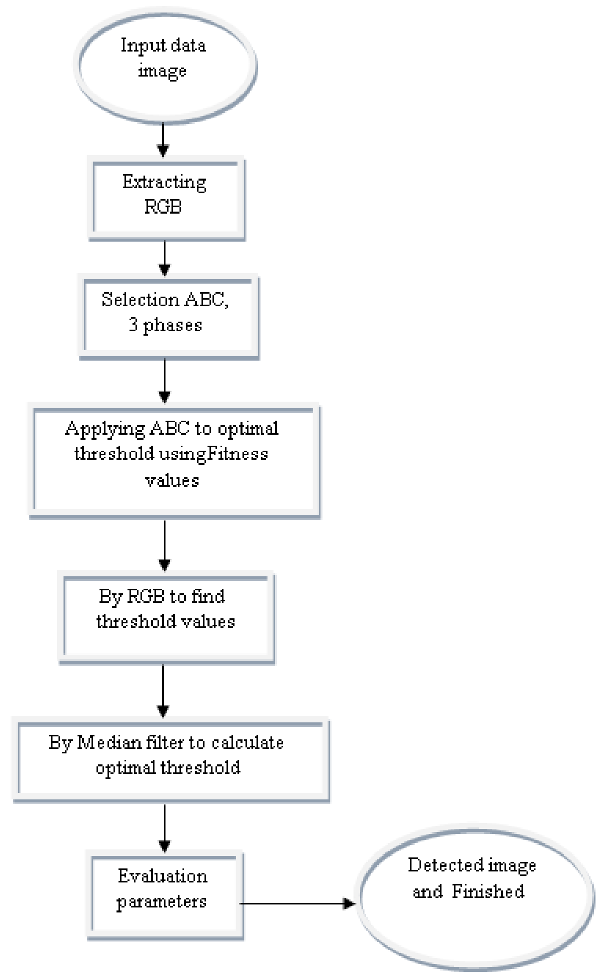

Fig. 3 Proposed Methodology of the Artificial Bee Colony Steps Evaluation.

By updating the superlative solution found so far, and iteration=iteration + 1, the ABC finally provided the threshold values for detecting the state of the skin tumor.

4. Simulation Result

This study was carried out by using MATLAB 2015b software. The quantitative estimation of the new algorithm was compared with other segmentation techniques, called the Level Set, JSEG,SRM and ASLM which have been measured for skin lesion images data [22,24,27,28]. The results are shown in Table 2.Three different parameters were chosen to compute the segmentation results from the equations below:

$$\text{Sensitivity} = \frac{\text{True detected melanoma(malignant)cases}}{\text{All melanoma (malignant)cases}} \quad (10)$$

$$\text{Specifity} = \frac{\text{True detected non melanoma(benign)cases}}{\text{All non melanoma (benign)cases}} \quad (11)$$

$$\text{Accuracy} = \frac{\text{True detected cases}}{\text{All cases (malignant + benign)}} \quad (12)$$

$$\text{Positive Predictive Value} = \frac{\textit{True detected melanoma(malignant)cases}}{\textit{Detected melanoma (malignant)cases}} \quad (13)$$

$$\text{Negative Predictive Value} = \frac{\textit{True detected non melanoma(benign)cases}}{\textit{Detected non melanoma (benign)cases}} \quad (14)$$

Table 2: Comparison of the proposed method and all methods of 200 PH2 database images.

Segmentation Method %	***Mode(type used of implementation segmentation)***	***Parameters***		
		Accuracy	***Sensitivity***	***Specificity***
SRM [27]	Semi-automatic	67.66	10.35	87.57
Level Set [22]	Fully-automatic	78.42	71.88	80.03
JSEG [24]	Semi-automatic	89.47	71.08	97.14
ASLM [28]	Fully-automatic	89.66	**80.24**	97.22
Proposed Method(ABC)	Fully-automatic	**93.01**	72.85	**98.00**

Table 3: Results of segmentation on eighty (common moles of skin dyes) from database pictures.

Segmentation Method %	***Parameters***		
	Accuracy	***Sensitivity***	***Specificity***
SRM	72.50	7.51	93.32
Level Set	79.96	70.69	82.62
JSEG	93.70	69.77	97.83
ASLM	94.77	**87.17**	97.60
Proposed Method(ABC)	**94.88**	70.42	**98.40**

Table 4: Results of segmentation on eighty (non-standard moles of skin dyes)from database pictures.

Segmentation Method %	***Parameters***		
	Accuracy	***Sensitivity***	***Specificity***
SRM	68.12	10.42	89.54
Level Set	79.85	73.64	82.37
JSEG	92.36	74.35	97.08
ASLM	92.71	**86.40**	97.33
Proposed Method(ABC)	**93.94**	66.77	**98.75**

Table 5: Results of segmentation on forty (malignant lesions of skin dyes) from database pictures

Segmentation Method %	***Parameters***		
	Accuracy	***Sensitivity***	***Specificity***
SRM	41.48	22.34	75.12
Level Set	72.49	70.73	70.15
JSEG	75.91	67.46	95.93
ASLM	66.15	54.04	95.97
Proposed Method(ABC)	**95.18**	**64.16**	**98.97**

Table 2.shows the comparison of images of 200 PH2 dataset between the proposed method and other methods. The ABC method was the most successful of all in terms of additional segmentation techniques on the utilized assessment parameters for accuracy and specificity. It is important to note that JSEG and SRM methods applied a semi-automatic method in the calculation of the experimental results, and other methods utilized a fully-automatic method in the segmentation. It should be noted that the dermoscopic pictures are named after the medical analysis. Three analytical kinds of common moles, nonstandard moles and malignant lesions of skin dyes will make it possible to complete a better examination. Table 3. shows results of segmentation of eighty (common moles of skin dyes) gained from the pictures in the dataset alone. It is obvious that the accuracy raises from 93.01 to 94.88 in the ABC method. The specificity rises from 98.00 to 98.40, and the sensitivity decreases72.85 to 70.42.

Table 4. the results of segmentation of eighty non-standard moles of skin dyes obtained from the database pictures. Likewise, the ABC algorithm is superior to the four methods. In this case, the accuracy of ABC method rises from 93.01 to 93.94, and the specificity rises from

98.00 to 98.75and,the sensitivity rises from 66.77 to 72.85.

Table 5. shows the results of segmentation on forty Malignant Melomnana (MM) lesions of the skin dyes taken from dataset pictures. In particular, ABC algorithm indicates that the value of the sensitivity rose from 64.16 to 72.85. As shown in Table 2, the value of the accuracy and specificity increased when compared with those in Tables (3,4),(i.e. this procedure made it easy to detect the Melomnana). Some results of segmentation proposed are exposed in Figure (4).

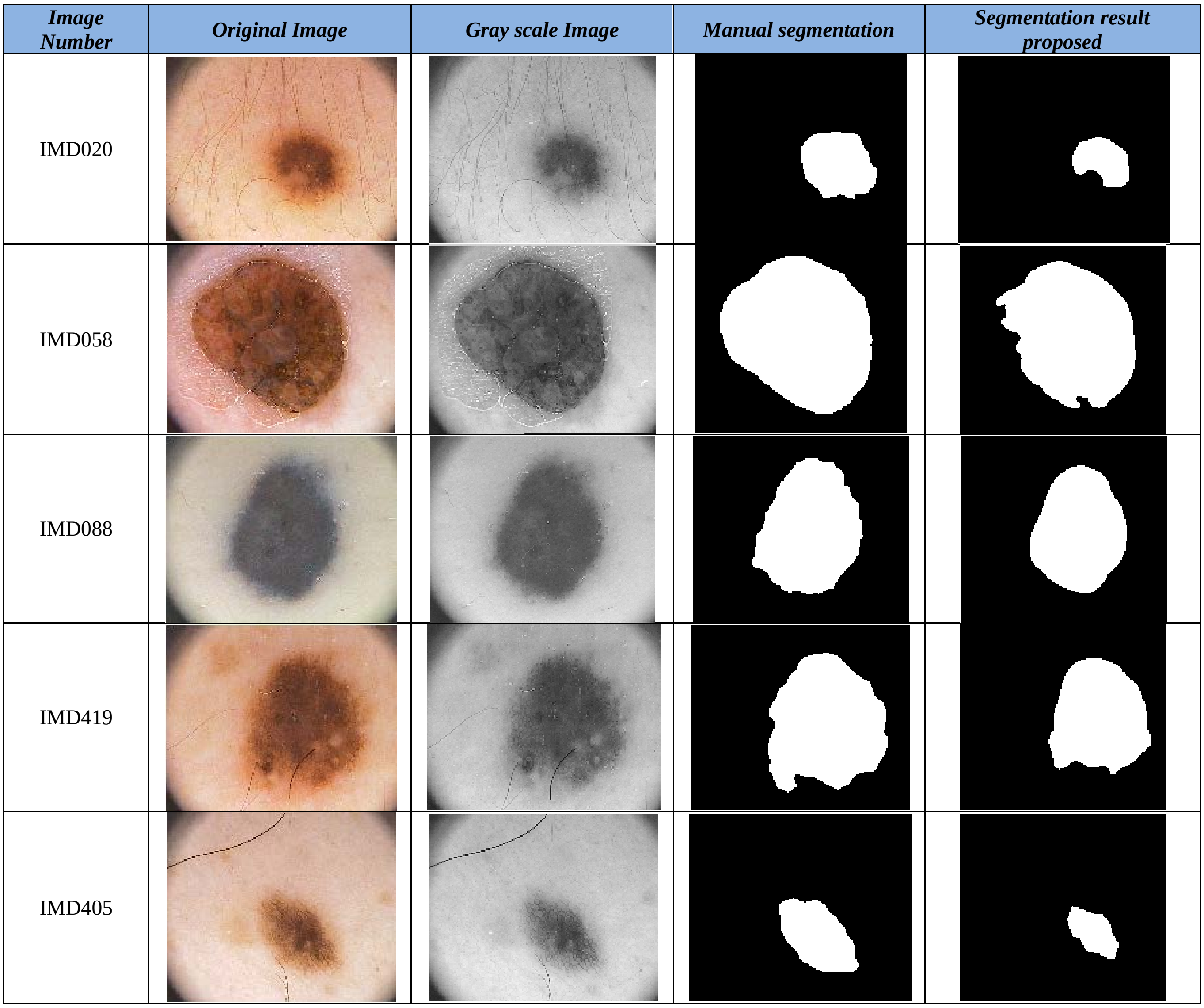

Fig. 4 Some results of proposed method for segmentation

Five melanoma images from PH2 dataset are chosen randomly and the detection was executed with the proposed technique. The specifics details are given in the Figure (4).The results of the proposed method of the Artificial Bee Colony segmentation taken from the dataset images of malignant lesions(melanomas) show that the specifications are IMD020 (blue-whitish veil and streaks) for the first row, IMD058 (regression areas and blue-whitish veil) for the second row,IMD088 (blue-whitish veil , regression areas and streaks) for the third row, and the IMD419 ,IMD405 are blue-whitish veil, for the fourth and fifth row.

5. Conclusion and Future work

The comparisons of the random ABC and direct ABC algorithms taken from the values of the numbers of iterations prove that direct ABC algorithm is very effective in the solving the numerical functions and limiting the detection of medical image processing. The connections between the agents in the inhabitants were used to get the best possible solution. In the ABC algorithm, the dance performance was achieved for share the information about position of the food sources. At this point, the information about direction plays a very important factor in reaching at a good solution despite the fact that the basic ABC algorithm is undirected and that such information is not shared in the artificial hive of the ABC.

In this paper, every dimension of every food source has field for the direction information, which is utilized for updating the location of food sources. This method, the information about direction was used to improve the convergence characteristic and local search ability of the basic ABC algorithm. The experiments show that this mechanism is better than the all techniques in solving the quality and convergence. The new model of the ABC algorithm uses the update equations rules of the fundamental In contrast to the survey models, the new model of the ABC algorithm uses update equation rules of the fundamental ABC method. The other update information rules will be used in ABC algorithm detect skin cancer earlier. This technique will be utilized to distinguish between the best and worst optimal solutions regarding this subject and to develop a better performance together. Briefly, the ABC is very accurate in detecting melanoma skin cancer although it is smaller than that of the benign lesions when images are treated. The accuracy and specificity equal to 93.01 and, 98.00 respectively. Equations of this method were compared with those of our methods to investigate update information.

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