International Refereed Journal of Scientific Research in Engineering (IRJSRE)
Volume 2, Issue 1 (January 2017), PP. 33-39

Study of Natural Terrain Classification UsingVarious Techniques Of Natural Computing

Deepam Sharma[1],Ashima[2], Ravneet Kaur[3] , Dr. Harish Kundra[4]
Research Scholar[1] Research Scholar[2] Research Scholar[3] Head Of Department[4]
R.I.E.I.T, R.I.E.I.T, R.I.E.I.T, R.I.E.I.T,
Railmajra,Punjab, INDIA Railmajra,Punjab, INDIA Railmajra,Punjab, INDIA Railmajra,Punjab, INDIA
deepam.sharma1@gmail.com[1] *07.ashima@gmail.com*[2] *rrvit.ravu@gmail.com*[3] *hodcseit@rayatbahra.com*[4]

ABSTRACT: Natural Computing is the field of research that deals with Computational technique.It is the field that connects the natural science with computing science both at the level of information technology and at the level of fundamental research.Image classification is defined as the labeling of images into the no. of predefined categories.Classification includes image pre-processing, image sensors, object detection and object segmentation.And to classify the image distinguish between the similar and dissimilar properties of image.Image Classification analyses the numerical properties of various image features and organize data in to the categories.The main objective of this paper to give review about the swarm based algorithms that are successfully implemented for satellite imagery data.In this paper,we give review about the algorithms BBO,CS,Fuzzy,PSO,ABC,HybridizationofFPAB/BBO,Fuzzy/BBO,ACO/BBO,CS/ACO,CS/PSO,PSO/BCO and CS/BBO and considering as kappa coefficient as comparison parameter.

Keywords: Image Classification,Cuckoo Search,Remote sensing,Optimization,Satellite image,PSO,ACO.

I. INTRODUCTION

Natural Computing encompasses with three classes of methods;those that take inspiration from nature for the development of novel problem solving techniques,those that are based on the use of computers to synthesize natural phenomena,those that employ natural materials to compute.

Image classification is the process by which different pixels of image are cosigned to different feature classes as per their identification found.Image Classification includes two phases: training and testing.In the training phases image features are isolated and unique feature of each classification and in the testing phase feature space portions are used to classify image features.The overall objective of this image classification is to change the digital image in to their respective feature [1].

Swarm intelligence is a soft computing technique. Swarm Intelligence (SI) is defined as the collectively problem-solving capabilities of social animals and insects.Swarm intelligence is a soft computing technique and it is inspired from the collective behaviour of social species like ants,bees,birds,termites[2].It is very innovative approach of artificial intelligence because of its amazing efficiency and improbable abilities of social insects to solve their simple food problems.Now a days it is accepted as the one of the most efficient optimization technique.It has highly efficient optimization behaviour.So,it can be applied on a variety of applications including function optimization,problem finding,optimal routes,scheduling,image and data analysis and image classification[3].It plays important role in the field of remote sensing for recognizing terrain features.The main aim of classification process is to categorize all the pixels of multispectral images in to all the terrain features for almost all the regions like water,urban,barren and rocky. Swarm based technique for remote sensing image classification.Remote sensed images are the images that are captured by the satellite.Image classification is extensively used for land cover mapping and now it is required that approach used for image classification should be more accurate and efficient.Soft computing technique that we use for image classification not able to provide good results.In the form of better results,for achieving better accuracy even with the low resolution satellite images and better land cover mapping.We are using satellite image for remote sensing.Examples of system studied by swarm intelligence are colonies of ants,bees,schools of fish,flock of birds. There exist various types of swarm intelligence based techniques like Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Cuckoo Search (CS), Artificial Bee Colony (ABC),Intelligent Water Drop(IWD),Shuffled frog leaping algorithm,Biogeography based algorithm,Bat algorithm and firefly algorithm. ACO (Ant Colony Optimization) is the technique for finding optimal paths.Based on the behavior of ants searching for food. It can be used to reduced to finding good paths from graphs.Ant drop markers everytime they bring food.HBO(Honey Bee Optimization) is based on the behaviour of honeybees.Honey bee swarms are capable of dividing tasks among bees in the swarm in intelligent manner.Bees perform their various day to day tasks like foraging, storing, retrieving and distributing honey bin a collective manner but without any central control.It is based on

the foraging behaviour of birds.The colony of artificial bees composed of following agents: employed bees, onlookers and scouts. Employed bees fly onto the sources which they are exploiting. Onlooker bees choose the sources by watching the dances performed by employed bees .Scouts choose sources randomly by means of some internal motivation or possible external clue. Cuckoo search is used for solving manyoptimization problems and real world applications.In Firefly algorithm,there are about thousands of firefly species and produce short and rhythmic flashes.The pattern of flashes is often unique for particular species.Function of flashes is to attract the mating partners.Attractiveness is proportional to their brightness.
Now all the techniques that are above written must be show in the figure1

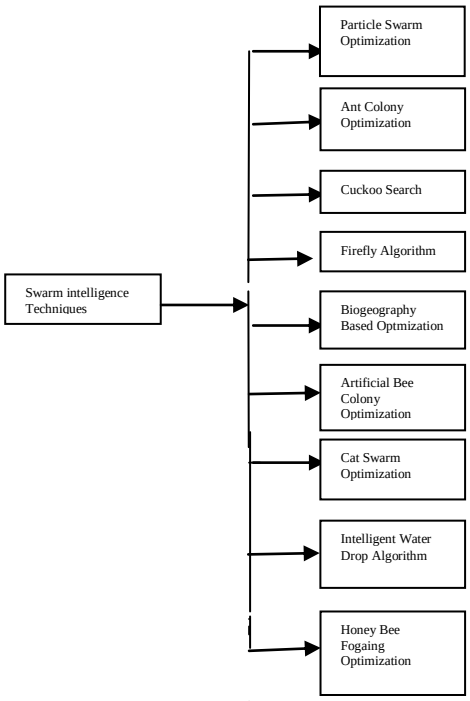

Figure 1 Swarm Intelligence Techniques [11].

There are no. of concepts that are used for the satellite image classification and for their comparison. These concepts are described as below:

A.Remote Sensing

Remote sensing is the acquisition of information about an object without making the physical contact with the object[4][5]. Remote Sensing can also be defined in a way that art of getting important information about the surface of earth and the objects of the surface without making any physical contact with the surface and object.It is done by sensing and recording the reflected or emitted energy and processing, analysing & applying that information. It is also known that a human being perceives all the information about the surrounding world with the help of his five senses. Remote Sensing involves a wide spectrum of sensing process. Based on the sensing elements, remote sensing can be categorized into two types: Active Remote Sensing and Passive Remote Sensing.

B. Satellite

A Satellite is defined as an autonomous receiver and transmitter device that has been introduced by human expertise in the outer space. The communication that occurs between the satellites to get the required amount of data on earth is known as satellite communication. In our day to day life all the cellular/T.V. channel that are transmitted to our homes with the help of satellite. With this advanced way of technology where some advanced concepts of fibre optics cables and digital switching systems introduced but the basic need of tele-communication is completed by satellite around the world. The two main kinds of satellites are Polar satellite and Geo-stationary satellites[6].

C. Image Classification

Image classification refers to the labelling of images into one of a number of predefined categories. Classification includes image sensors, image pre-processing,object detection, objectsegmentation, feature extraction and object classificationTo classify the image,having similar properties at one side and contain

dissimilar properties on other side.Selection of classification depends on: Nature of data being analysed,Computational resources available and Intended application of classified data. Formally, Image Classification can be defined as the process by which different pixels of the image are consigned to different feature classes as per their identification found[7][8]. The main objective of the image classification is to change the digital image into the respective feature class categorization so it can be used for the real life problem. There exist various spectral patterns which are used as the numerical basis to categorize them into different feature classes. Image Classification is of two types: Supervised Learning and Unsupervised Learning. Image Classification techniques can be broadly classified into three categories Statistical Classifiers, Fuzzy Mathematical based approaches and Artificial Intelligence based techniques.

D.Accuracy Assessment

Accuracy Assessment is the very important tools of remote sensing to check the accuracy level of the classification done. In Accuracy Assessment, the term 'accuracy' typically refers to degree level of correctness in the mapping of the remote sensing data obtained[9]. The accuracy of a classification a can be evaluated by making comparison of reference with the classified data obtained[10]. Reference data is true value data that is generated from the ground truth, high resolution satellite data and always considered to be accurate. In case the reference data is found to be incorrect, then the classification will be poor. Accuracy assessment is totally depends upon the number of iterations that are carried out. The main aim of the accuracy assessment is to calculate that how efficiently the pixels are considered into correct feature classes of the investigation area. It is not possible in the real world problems to check each and every object for accuracy.

In this paper, we are giving an overview of the existing swarm intelligence techniques that are used for the Image classification.

Rest of the paper is organized as:Section 2 gives briefs introduction about the Literature survey of the existing techniques. Section 3 gives the comparison of results and section 4 concludes the paper and Section 5 proposed future scope of this paper with some future references.

II. LITERATURE SURVEY

Panchal et al (2009) described the Modified Biogeography Based Optimization (BBO) algorithm, provides classification of the natural terrain features. This paper described the various biogeography techniques to explain the nature of the different social species that shift the living place according to the Habitat Suitability Index (HSI). This process is done by using specific algorithm. The algorithm helps to present the social species like pixels of images and environmental living area like land cover features. This classifier gives the better output as compare to other existing classifier. In this comparison will be done by using kappa coefficient(KC), where kappa coefficient provides the accuracy value like 0.6715 which is good as compare to the other existing classifications [12].

Panchal et al(2009) gives a various classification rules for extraction by using Ant Miner Techniques (AMT).Ant Miner Technique works like as Ant Colony Optimization Technique which is used to extract various features. This paper provides various AMT to gives the solution of optimization problems and classifications [13].

Panchal et al (2010) proposed the hybrid concept for Biogeography Based Optimization (BBO)and Ant Colony Optimization (ACO) [14]. In this paper, biogeography based optimization provides the classification of land cover feature and output of this classification not enough for the original classification for the features except water and vegetation. ACO provides the good output for all features except water. By comparing these two techniques to get better results like BBO technique helps to find accurate features of water pixels and ACO techniques apply for other areas like vegetation, urban rocky and barren pixels. In this way hybridization of ACO 2/BBO provides good results as compare to individually BBO and ACO classification techniques.

Jahal et al (2010) proposed the satellite image classifications by using hybrid concept of Flower Pollination by Artificial Bees (FPAB) with BBO. In this, clustering concept used to classify the satellite images and clustering of pixels of the images done by FPAB and BBO used to clustering for the other pixels again. FPAB clustering of pixels further proceeded by BBO clustering concepts [15]. There are two types of cluster are used, one for the five classes of the dataset image and second is universal habitat for the artificial bees. In this data defined in the seven band satellite images of the Alwar region Rajasthan, which contains a variety of land cover features.

Gupta et al (2011) described the remote sensing image classification by using biological partition of living cells.Membrane computing is one of the good biological concepts. Membrane computing divided in two ways, inside membrane and outside membrane. The inside membrane further divided in membrane elements and outside membrane does not contain any further membrane elements. In this classification of images will be done

by using membrane elements of the membrane. This classification process is done with the help of some rules which are generated by cell membrane on the Alwar region and this is provides the better results [16].

S.Goel (2011) described the solutions for image classifications problems by using hybrid concept of swarm based algorithms.

This technique acknowledged as self-organization features maps and Ant Colony Optimization. To solve the high spectral remote sensing images is done by using hybridization concepts. Pheromone updations is also one of the new methods for ants of ACO used to get more accurate results [17]. In this paper, hybridization provides the more accurate results as compare to BBO and PSO.

L. Goel (2011) described the biogeography base optimizations (BBO) and digital number (DN) values for pixels of image for land cover feature classifications. This paper provides the proposed information of image classification for land cover feature extractions and it represents the efficiency of the classification be inversely proportional to the entropy of the land cover feature the particular selected land cover area where every band taken under practical examinations. The entropy of particular region is low and high is depends on the accuracy value of the land feature, like if the land feature value is high then entropy will be low of that particular region [18]. Alwar region is the dataset used for terrain classifications with satellite images of the seven bands and these bands contains variety of land cover features like vegetation, rocky, urban, water, barren etc. The end results of the classification of social species of BBO as pixels of the images compared with entropy of the number of different features of the land cover.

Banerjee et al(2012)uses the Artificial Bee Colony Optimization (ABC) to introduce the Remote Sensing image classification [19]. Three types of bees are included in this optimization-employed bees, onlooker bees and scout bees. Alwar region which have seven bands satellite imges constituted from Canadian and Liss-III satellite is taken as dataset for image classification.This classification uses the Euclidean distance formulation, in which the image pixels are acknowledged as the bees, and adjacent pixels are picked by conceding the guidelines of onlooker bees. Kappa coefficient which is taken as accuracy parameter gives a higher value as a result. The kappa value of ABC gives larger certainty as confrontred to Biography Based Optimization (BBO), Fuzzy set, Membrane Computing (MC) and various classifiers like Minimum to Mean Distance (MDC) and Maximum Likelihood Classifiers (MLC) etc.

Arora et al. (2012) put forward the composite abstract idea of Artificial Bee Colonyoptimization (ABC) and Biogeography Based Optimization (BBO) for the distillation of inborn terrain characteristic extraction [20]. The given hybrid conception succeeded in dealing with the unfavourable conditions of the cluster methods used in the BBO algorithm for the image classification. BBO classes get the facts or news of HSI index from additional kinds of Cuckoo search, is the core concept of hybridization. This means the point of supply of food and appropriate atmosphere are assent to as a land cover aspect which includes urbanization water area, vegetation part, hilly area etc. Here, for the image classification, image pixels are conceded for the collective varieties of the bees and the HSI Index of the band images are tallied. The dataset examined for the analysis of different angle foothold extend like Alwar and Rajasthan.The effects brought out by this hybridization idea are superior as confront to the easily understood BBO algorithm with certainty rate.

Bharadwaj et al. (2012)has pre-owned the Swarm based most recent concept Cuckoo search algorithm for the exposure of inborn land cover components. The benefits of the Cuckoo bird to cache his eggs to alternate species nest is used to hold the natural terrain attribute. As compared to the additional swarm based approaches, the cunning Cuckoo bird can achieve better results. Here for the image classification Alwar area is used as the dataset. To fund the eggs Cuckoo bird is treated as the pixel value of the image and the owner nest is seized as the same kind (i.e. terrain attributes), in this recommended algorithm. Distant species are useful in hoarding the eggs. Inconsistent classes are helpful in storing unlike terrain characteristics as when they get spotted. The effects accomplished by this are precise as examined to others Swarm based algorithm like ABC, BBO, PSO and widespread classifiers [21]. With the help of certainty rate of the classified image features can be clipped.

L. Goel et al. (2012)submitted the inborn stimulated estimation intelligence by categorizing them into a new genetics. The examination of human mind objects, simulation invulnerable system based, swarm intelligence based and various other met heuristics ways are accounted by them. They organize all the nature influenced methods and gives anatomy based on this assortation. Concise contention with reference to the usual classifiers of image classification which includes Minimum Distance Classifier, Maximum Likelihood classifiers and Parallel-o-piped classifiers ways are described. Due to low certainty terrain values evocation, the closest value diminishes with the addition in the firmness of the satellite image [22].

L. Goel et al. (2013) has proposed the biogeographically based algorithms for the allocation of natural terrain attributes and distinguishes them with miscellaneous Swarm based algorithm like Ant Colony Optimization, Bee Colony Optimization, Particle Swam Optimization and Biogeography Based Optimization methods, based on the facts allotment wealth for the labelling of the inborn terrain attributes. In this paper authors come to an end that the facts allotted swarm based algorithm are useful in the cumulation of the other complicated situations and the image classification of satellite inscription [23]. The belief started by the author to maintain an algorithm can be helpful in blowing up of the distribution of additional inborn terrain attributes, but this algorithm is not helpful in giving exact results which is maintained for the real land used.

Kundra and Sadawarti (2013) has presented the hybrid algorithm of cuckoo search and ant colony optimization for the labelling of inborn terrain characteristics. The effects gained from the this algorithm are excellent to those of additional hybrid advents. The rate of kappa coefficient appears to be 0.9445 which is near to attain the exactitude estimation [24].

Kundra and Sadawarti (2015)has contended the hybrid algorithm of cuckoo search and particle swarm optimization for the distillation of inborn land cover attributes [25]. By using the kappa allowance the certainty estimated amount exposed to be 0.9633.

Dr. Harish Kundra, AnikaRana (August 2015)
This paper described the hybrid concept of Particle Swarm Optimization (PSO) with Bee Colony Optimization (BCO) to find the optimal path. PSO algorithm used to find obstacle detection from the satellite images and BCO algorithm used to avoid the obstacles and to find the shortest path to achieve the goal.In this, obtained results and values are more efficient and effective to extracts the background data and sort the data by using shortest path and in safest way. There is overall accuracy is 97.08%.

Sakshi Sharma, PoojaNagpal (November 2015)
Proposed the hybridization concept of Cuckoo Search 9CS) with the Biogeography Based Optimization (BBO) for the classification of satellite images. This hybridization gives the more accurate and improved results as compared to other algorithms. This algorithm gives the overall accuracy is 97.33%.

3. COMPARISON

For comparison, we are considering kappa coefficient as the comparison parameter [11]. The kappa value of different algorithms is compared as below in figure 2:

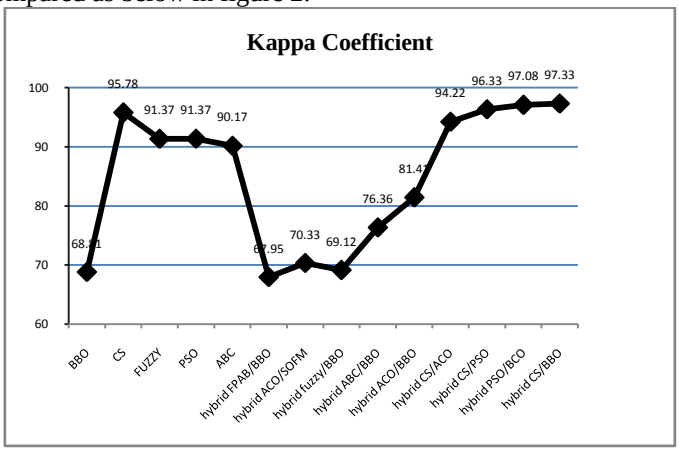

Figure 2Differentiations by using Kappa Coefficient [11][27].

From the derived chart, it is estimated that for the hybrid algorithm of cuckoo search and particle swarm optimization the kappa value is greater.In the latest search hybridization of particle swarm optimization and bee colony optimization and hybridization of cuckoo search and biogeography based optimization shows more accuracy. Hence, shows the high accuracy level [27].

III. CONCLUSIONS

From the above figure, it can be conclude that the results obtained are accurate enough to classify the satellite image. Askappa coefficient is the most important key parameter to measure the accuracy level of the algorithm.The main objective of of this research work was to classify the satellite image into different landcover/terrain features. And also shows the justification of methods that provides accurate and efficient results as compare to other nature inspired

techniques. The proposed algorithm gives the efficient results as compare to individual CS & ABC and other Swarm intelligence techniques.

.

IV. FUTURE SCOPE

Further,we proposed the three algorithms which are hybridization of cuckoo search and firefly algorithm,PSO and firefly algorithm and the hybridization of BCO and firefly algorithm to achieve better result.The main aim of hybridrization of these algorithms to classify the satellite image in terms of Kappa Coefficient Value and it will provide better results as compare to previous techniques

REFERENCES

[1]. E. Bonabeau, M. Dorigo, and G. Theraulaz. Swarm intelligence: from natural to artificial intelligence. Oxford University Press, 1999. ISBN 0-19-513158-4.

[2]. Kennedy, J., Kennedy, J. F., & Eberhart, R. C. (2001). Swarm intelligence. Morgan Kaufmann.

[3]. Blum, C., & Li, X. (2008). Swarm intelligence in optimization (pp. 43-85). Springer Berlin Heidelberg.

[4]. Jensen, J. R. (1996). Introductory digital image processing: a remote sensing perspective (No. Ed. 2). Prentice-Hall Inc..

[5]. Sabins Jr, F. F. (1978). Remote sensing. Remote sensing.

[6]. Joseph, G. (2005). Fundamentals of remote sensing. Universities Press.

[7]. Haralick, R. M., Shanmugam, K., & Dinstein, I. H. (1973). Textural features for image classification. Systems, Man and Cybernetics, IEEE Transactions on, (6), 610-621.

[8]. Jensen, J. R. (1996). Introductory digital image processing: a remote sensing perspective (No. Ed. 2). Prentice-Hall Inc.

[9]. Stehman, S. V., & Czaplewski, R. L. (1998). Design and analysis for thematic map accuracy assessment: fundamental principles. Remote Sensing of Environment, 64(3), 331-344.

[10]. Foody, G. M. (2002). Status of land cover classification accuracy assessment. Remote sensing of environment, 80(1), 185-201.

[11]. Er. Sakshi Sharma, Er. PoojaNagpal, Er. Harish Kundra, A Review on the Satellite Image Classification using Swarm Intelligence based Techniques, International Journal of Advances in Science and Technology (IJAST).

[12]. Panchal, V. K., Singh, P., Kaur, N., &Kundra, H. (2009). Biogeography based satellite image classification. arXiv preprint arXiv:0912.1009.

[13]. Panchal, V. K., Singh, P., Narula, A., & Mishra, A. (2009, December). Review on Ant Miners. In Nature & Biologically Inspired Computing, 2009.NaBIC 2009. World Congress on (pp. 1641-1644). IEEE.

[14]. Panchal, V. K., &Goel, L. (2010, December). Land Cover Classifications using Hybrid Bio-Inspired Technique in Remote Sensing. In International Conference on Soft Computing and Pattern Recognition (SocPaR 2010), Paris, France (pp. 7-10).

[15]. Johal, N. K., Singh, S., &Kundra, H. (2010).

[16]. A hybrid FPAB/BBO algorithm forsatelliteimageclassification.International Journal of Computer Applications (0975– 8887), 6(5).

[17]. Gupta, D., Das, B., &Panchal, V. K. (2011). A methodical study for the Extraction of Landscape Traits usingMembrane Computing Technique.Worldcomp, Las Vegas, USA.

[18]. Goel, S., Sharma, A., &Panchal, V. K. (2011). A Hybrid Algorithm for Satellite Image Classification.In Advances in Computing, Communication and Control (pp. 328-334).Springer Berlin Heidelberg.

[19]. Goel, L., Gupta, D., &Panchal, V. K. (2011, December). Performance governing factors of biogeography based land cover feature extraction: An analytical study. In Information and Communication Technologies (WICT), 2011 World Congress on (pp. 165-170). IEEE.

[20]. Banerjee, S. R. I. D. E. E. P. A., Bhardawaj, A., Gupta, D., &Panchal, V. K. (2012). Remote Sensing Image Classification using Artificial Bee Colony Algorithm. International Journal of Computer Science and Informatics, 2(3), 67-72.

[21]. Arora, P., Kundra, H., &Panchal, V. K. (2012). Fusion of biogeography based optimization and artificial bee colony for identification of natural terrain features. International Journal of Advanced Computer Science & Applications, 3(10).

[22]. Bharadwaj, A., Gupta, D., &Panchal, V. K. (2012). Applying nature inspired metaheuristic technique to capture the terrain features. In Proceedings of the 2012 International Conference on Artificial Intelligence (ICAI-2012) (Vol. 1).

[23]. Goel, L., Gupta, D., Panchal, V. K., & Abraham, A. (2012, November). Taxonomy of nature inspired computational intelligence: A remote sensing perspective. In Nature and Biologically Inspired Computing (NaBIC), 2012 Fourth World Congress on (pp. 200-206). IEEE.
[24]. Goel, L., Gupta, D., &Panchal, V. K. (2013). Land Cover Feature Extraction of Multi-spectral Satellite Images Based on Extended Species Abundance Model of Biogeography. In Transactions on Computational Science XXI (pp. 90-118).Springer Berlin Heidelberg.
[25]. Kundra, H., &Sadawarti, H. (2013), Hybrid Algorithm of CS and ACO for Image Classification of Natural Terrain Features, IJACSCE.
[26]. Kundra, H., &Sadawarti, H. (2015), Hybrid Algorithm of Cuckoo Search and particle Swarm Optimization for Image Classification of Natural Terrain Features, Research Journal of Information Technology, pp. 58-69.
[27]. Dr. Harish kundra, Er.AnikaRana Hybrid Algorithm of PSO and BCO for Image Classification of Natural Terra Features, International Journal of Computer Science and Communication Engineering Volume 4 issue 2 (August 2015 issue).
[28]. Sakshi Sharma, PoojaNagpal, Satellite Image Classification using Hybrid Cuckoo Search & Biogeography Based Optimization, International Journal of Advances in Computer Science and Communication Engineering (IJACSCE) Vol 3, Issue 2 (November 2015).