BIOGEOGRAPHY BASED OPTIMIZATION ITS APPLICATIONS- A REVIEW

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***ABSTRACT* : Biogeography-Based Optimization (BBO) is population based algorithm. Biogeography is the study of the geographical distribution of biological organisms. Biogeography-based optimization (BBO) is an optimization technique introduced by Dan Simon in 2008. This technique is based on the theory of biogeography. This optimization algorithm works on the basis of two concepts-migration and mutation. The paper discusses about biogeography based optimization, algorithm and its applications.**

***KEYWORD* : Biogeography-Based Optimization (BBO), Evolutionary Algorithm, Migration, Mutation.**

INTRODUCTION

The science of biogeography can be traced to the work of nineteenth century naturalists such as Alfred Wallace and Charles Darwin. Until the 1960s, biogeography was mainly descriptive and historical. In the early 1960s, Robert MacArthur and Edward Wilson began working together on mathematical models of biogeography, their work culminating with the classic 1967 publication The Theory of Island Biogeography. Their interest was primarily focused on the distribution of species among neighboring islands. They were interested in mathematical models for the extinction and migration of species. Since MacArthur and Wilson's work, biogeography has become a major area of research. However, a search of INSPEC, an engineering research index, reveals that no biogeography papers have ever been written. In view of this, part of the motivation of this paper is to merge the burgeoning field of biogeography with engineering in order to see how the two disciplines can be of mutual benefit. The application of biogeography to engineering is similar to what has occurred in the past few decades with genetic algorithms (GAs), neural networks, fuzzy logic, particle swarm optimization (PSO), and other areas of computer intelligence. Mathematical models of biogeography describe how species migrate from one island to another, how new species arise, and how species become extinct. The term "island" here is used descriptively rather than literally. That is, an island is any habitat that is geographically isolated from other habitats. We therefore use the more generic term "habitat" in this paper (rather than "island"). Geographical areas that are well suited as residences for biological species are said to have a high habitat suitability index (HSI). Features that correlate with HSI include such factors as rainfall, diversity of vegetation, diversity of topographic features, land area, and temperature. The variables that characterize habitability are called suitability index variables (SIVs). SIVs can be considered the independent variables of the habitat, and HSI can be considered the dependent variable. Habitats with a high HSI tend to have a large number of species, while those with a low HSI have a small number of species. Habitats with a high HSI have many species that emigrate to nearby habitats, simply by virtue of the large number of species that they host. Habitats with a high HSI have a low species immigration rate because they are already nearly saturated with species. Therefore, high HSI habitats are more static in their species distribution than low HSI habitats. By the same token, high HSI habitats have a high emigration rate; the large number of species on high HSI islands has many. Restrictions apply.HSI remains low, then the species that reside there will tend to go extinct, which will further open the way for additional immigration. Due to this, low HSI habitats are more dynamic in their species distribution than high HSI habitats.

1. The basis of BBO algorithm is based on two main parts: Migration and Mutation.

a) MIGRATION

In BBO algorithm, a population is selected as a solution. This solution can represent as a vector of real numbers that each real number is a SIV in BBO algorithm. The fitness of each solution can be calculated with its objective function. This fitness is the same HSI in BBO algorithm.

b) MUTATION

Sudden changes in climate of one habitat or other incidents will cause the sudden changes in HSI of that habitat. In BBO algorithm, this position can **be** model in the form of sudden changes in value of SIV. Each member of one habitat has its own possibility. If this possibility is too low, then this solution has high possibility to mutate. In the same manner, if possibility of **a** solution is high that solution has a little chance to mutate.

Algorithm the basic BBO algorithm.

1 Randomly initializes a population of P solutions (habitats);

2 while stop condition is not met do

3 Sorting the habitats in decreasing order of fitness;

4 Calculate the migration and mutation rates of the habitats;

5 for p = 1 to P do

6 for i = 1 to n do

7 if rand() < _p then //migration

8 Select a habitat Hq with probability / _q;

9 Hp;i Hq;i;

10 for p = 1 to P do

11 for i = 1 to n do

12 if rand() < _p then //mutation

13 Hp;i li + rand() _ (ui li);

14 Evaluate the fitness values of the habitats;

15 Update the best known solution;

16 return the best known solution.[9]

2. Application of Biogeography-based Optimization for Economic Dispatch Problems.

2.1 Bio geographical Based Computing and its application (June 2012).

S. Dahiya et al. : Biogeography-based optimization (BBO) algorithm has been presented for solving the economic dispatch problems. An optimal short-term thermal generation schedule for 24 time intervals has been presented for the same reason. The same bbo algorithm can be implemented on two different system i.e. first consist of three generators and the second consist of six generators. The observations are compared with the conventional Lagrange multiplier method and the particle swarm optimization (PSO) method. The observation shows BBO algorithm is better than any other algo in term of fuel cost as compared to other methods. Also, the whole enhanced and premature search **is** avoided.

2.2 Survey on Biogeography Based Optimization Algorithm and Application of Biogeography Based Optimization to determine Parameters of PID Controller (February 2014).

S. Malik et al. : Biogeography is the study of the distribution of species over space and time. But now a days theory of biogeography has been applied for solving difficult engineering optimization problems. The algorithm that is mostly used in biogeography based optimization (BBO).In this paper, a brief survey on biogeography based optimization is taken out. The system model of immigration and emigration of organisms in an island biogeography system is used as the basis of BBO to find unknown parameters of PID controller because it is difficult to achieve the proper values of the parameters Kp, Ki and Kd in PID controller. The approach is based on the search for global optimum value for the PID control parameters with the help of cost functions which converges to minimum value and error**.** Finally the responses of time and frequency domains are found with the help **of** simulation and then compared.

2.3 Biogeography-Based Optimization for the solution of the Combined Heat and Power Economic Dispatch Problem (July 2013).

S.Aravind et al. : In this paper a new approach for the solution of the Combined Heat and Power Economic Dispatch Problem(CHPED) is being presented using Biogeography based optimization Biogeography(BBO).It is a type of evolutionary algorithm which is based on the theory of biogeography and is inspired from the two concepts-migration of species between “islands” via flotsam, wind, flying, swimming, etc. and mutation. The proposed test system takes into account seven units and also a comparison with Artificial bee colony Algorithm (ABC) is being made. From the results it is seen that BBO provides best solution than ABC**.**

2.4 Biogeography-Based Optimization Algorithm for Load Dispatch in Power System (July 2013).

J.Jain et al. : This paper presents a biogeographic-based optimization (BBO) algorithm to solve Economic Load Dispatch (ELD) problem with generator constraints in power plants. Biogeography is basically a science of geographical distribution of the biological species. The models of biogeography explain how an organism arises, immigrate from an environment to another and gets eliminated. This method is based on two steps mutation and migration. Unlike other GA & PSO, BBO also have some common features. The purpose of this work is to find out the advantages of application of the evolutionary computing technique and BBO in particular to the economic load dispatch problem. This technique is implemented in MATLAB environment.

2.5 Dynamic Deployment of Wireless Sensor Networks by Biogeography Based Optimization Algorithm (2012).

G. Wang et al. : As the development and usage of wireless networks increases, problems related to that become more apparent. Development is the main term that affect the performance of the wireless networks. In this paper, biogeography-based optimization is applied to the dynamic deployment of static and mobile sensor networks to achieve better performance by increasing coverage area of the network. For this, a binary detection model is believed to obtain realistic results. At last Performance of the algorithm is compared with that of the artificial bee colony algorithm, Homo-H-VFCPSO and stud genetic algorithm that are also population-based optimization algorithms. The Results show biogeography-based

optimization can be preferable in the dynamic deployment of wireless sensor networks.

2.6 Biogeography-Based Optimization for Hydraulic Prosthetic Knee Control.

T.Wilmot et al. : Cyber-physical systems (CPS) include a number of challenges that we address in this research. In this paper, the open-loop control development and simulation results for a newly-developed cyber-physical system (CPS) used as a semi-active above-knee prosthesis. The control signal of our CPS consists of two hydraulic valve settings that control a linear cylinder actuator and provide torque to the prosthetic knee. We create open-loop control using biogeography-based optimization (BBO), which is a recently developed evolutionary algorithm. The research provide to the field of cyber-physical systems by showing that it is possible to find effective open-loop control signals for our newly proposed semi-active hydraulic knee prosthesis through a dual-system optimization process which includes both human and robot control search parameters.

2.7 Biogeography based Satellite Image Classification (2009).

H. Kundra et al. : Biogeography is the study of the geographical distribution of biological organisms. The mindset of the engineer is that we can learn from nature. Biogeography Based Optimization is a burgeoning nature inspired technique to find the optimal solution of the problem. Satellite image classification is an important task because it is the only way we can know about the land cover map of in accessible areas. Though satellite images have been classified in past by using various techniques, the researchers are always finding alternative strategies for satellite image classification so that they may be prepared to select the appropriate technique for the feature extraction task in hand. This paper is focused on classification of the satellite image of a particular land cover using the theory of Biogeography based Optimization.

2.8 A Survey on Comparison between Biogeography Based Optimization and Other Optimization Method (February 2013).

G. Kaur et al. : Optimization strategies have gained wide importance in solving complex problem. Biogeography Based Optimization (BBO) is a population based evolutionary algorithm that is based on the mathematics of biogeography. Many optimization algorithms like genetic algorithm, ant colony optimization etc. are used in different fields for example in image processing. BBO algorithm based on two concepts i.e. Migration and Mutation. In this paper, we compare BBO and other optimizations.

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