PBBO: A New Approach for Underground Water Analysis

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ABSTRACT
From last ten to fifteen years many optimization techniques have been evolved and enhanced. Out of those, PSO and BBO are the two techniques that have been widely used in Swarm Optimization. PSO is better in comparison many genetic algorithms. PSO has applications in various areas like Optimization, Neural Networks training, Fuzzy controls and etc. BBO is based on science of biogeography. BBO has some features common to PSO and Genetic algorithms but it has some important features that make it more reliable than others. In this paper, we have proposed new algorithm that combines the features of PSO and BBO. It will help in providing more reliability in optimization world.

KEYWORDS
PSO, BBO, GA, Optimization, Underground Water Exploration.

1. INTRODUCTION
PSO algorithm was in original developed by doctors Eberhart and Kennedy. It was based on stochastic optimization technique. PSO is first populated with random solutions and then search for optimum solution by repetitions. In this method, the behavior of bird is simulated. It is assumed that there are number of birds that are searching food in a location and there is only single piece of pray is present is there. There are only few birds that know where the pray is present. Then the best solution for the remaining birds is that follow the birds which is nearby to pray. In PSO algorithm, bird is known as particle. We use a fitness function in which different values are given to particles which is then optimized. The particles have their particular positions and velocities in starting and then afterwards go on changing in search of pray. After every repetition, every particle updates its two values. First one is the value that it has gained and other one is the best value by optimization that is achieved so far. These are stated as pbest and gbest respectively. The two equations are used by particle to update its velocity and position is

$$Vel[\,] = Vel[\,] + C1 + C2 \qquad (1)$$

$$where$$

$$C1 = const1 * rand(\,) * (pbest[\,] - present\,[\,]$$

$$C2 = const2 * rand(\,) * (gbest[\,] - present[\,]) \qquad and$$

$$present[\,] = present\,[\,] + Vel[\,] \qquad (2)$$

Here Vel [ ] is the velocity of particle and Present [ ] is current result of particle.const1 and const2 are learning factors. Here both are takes as 1.

1.1 Pseudo Code for PSO is
For each particle
Initialize the particle
End
Do
For each particle
Find out the fitness value of each particle
If current value of pbest is good against value in history then
Set current value as pbest
End
Select the gbest as the best fitness value of all the particles.

For each particle
Find out the particle velocity for equation 1.
Increment the position of particle by using equation 2.
End
Repeat while maximum iterations or the criteria of minimum error are not attained.

On each position velocity of particle is equated to a maximum velocity as Vmax. If the sum of accelerations try to exceed the velocity from the input value which is given by the researcher then the velocity is limited to Vmax.

BBO (Biogeography Based Optimization) was introduced by simon and is used for global optimization. Here species immigrate or emigrate between islands in search of more friendly habitats. Each result is known as habitat and each has habitat suitability index (HSI) which is a vector. Each individual is represented with some initial random value and good HSI values are retained. Both high and low HSI values share their features. The migration and mutation operators are used for generating the new habitat from the all the solution in the problem. BBO migration is helpful to change present solution and modify existing island.

The probability Xi is proportional to the immigration rate Yi and the source of probability is proportional to the emigration rate Uj.

Procedure for Habitat migration is

```
Start
      For i = 1 to N

  Select Xi with probability based on Yi
 if rand(0,1)< Yi  then

       for j = 1 to N
   Select Xi with probability based on Uj
   if rand(0,1)< Uj then
  Randomly select an index vector σ from Xi
  Replace a random vector in Xi with σ
    end if
    end for
    end if
    end for
   End
```

While mutation is based on probability that modifies the index vectors randomly this depends on the priority of probability of existence. Here we ignore the very high HSI and very low HSI and take the medium HSI.

Procedure for mutation is

```
Begin
    for i = 1 to N
       calculate the probability Pi
       select vector Xi(j) dependent on Pi
      if rand(0,1) < mi       then
  replace Xi(j) with randomly generated    vector
      end if
     end for
End
```

The mutation rate is defined as:

$$m = m_{\max}\left(\frac{1-P_s}{P_{\max}}\right) \qquad \textbf{(3)}$$

Here m_{max} is user defined and here it is 2.

Diversity of population is increased by this mutation process.

2. PROPOSED ALGORITHM

The proposed enhanced model will use the basics of BBO and PSO.

For each particle
Initialize particle
For each particle
Calculate fitness value
If the fitness value is better than the best fitness value (pbest) in history
set current value as the new pbest
End
Choose the particle with the best fitness value of all the particles as the gbest
For each particle
Calculate particle velocity according to Eq. 2
Update particle position according to Eq.1
End
Consider each feature as one habitat.
For each particle
Total no. of habitat = universal + feature habitat
Define HSI, Smax, Smin, immigration rate and emigration rate.
Find HSI for each other feature habitat.

Z) Select image area from universal habitat and migrate it to one of the other habitat and recalculate HSI.
If recalculated HSI is within limit then absorb the species to that habitat else.
Check for the other habitats and recalculate the HSI.
If all species in universal habitat are checked then stop else go to step Z.

Continue till max. iterations or min. error criteria is not attained.

Here habitat is group of pixels around corners where pixel with best value is located

3. ATTRIBUTES USED IN DATASET

Table 1. List of sample attributes

Geology	Sedimentary, Igneous, Metamorphic, Alluvium
Soil	Sand, Gravel, Clay or Cracked rock, Silt
Nature of Land	Agricultural, Coarse sand, Grave land , Plain, Riverbed, fissured sandstone
Quality of Soil	Highly dissolved, low dissolved and Medium dissolved with organics
Thickness of Soil	Soil = 2mm, Sand = 2- 0.05, Silt = 0.05- 0.002, Clay < 0.002
Mineral present in Soil	Montmorillonite, Illite, Nontronite, Kaolinite, Hydrated Halloysite, Chlorite, Attapulgite

4. RESULTS

We first take the sample of soil and then put the attributes in the database and then apply the new algorithm on the dataset. The sample dataset is taken as

Table 2.The sample dataset

Geology	Alluvium
Soil	Clay
Nature of Land	Agricultural
Quality of Soil	low dissolved with organics
Thickness of Soil	Clay < 0.002
Mineral present in Soil	Kaolinite

Here we emigrate the species to different habitats. The graphs on X-axis shows the values 1, 2 and 3 for Low, medium and high habitat. On Y- axis the numbers of species are taken.

Table 3. Shows no. of species before emigration

Low Habitat	120
Medium Habitat	66
High Habitat	92

Table 4. Shows no. of species after emigration

Low Habitat	110
Medium Habitat	60
High Habitat	85

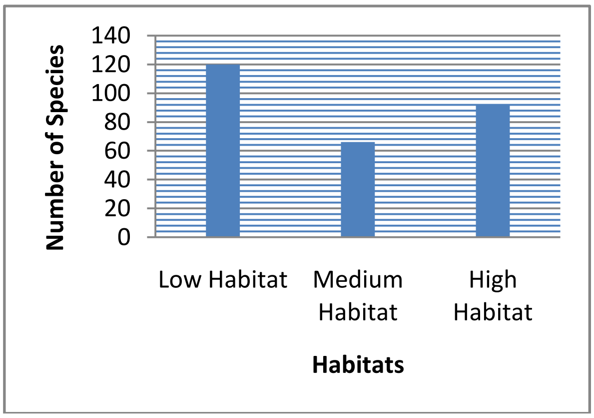

Figure 1: Results before the emigration

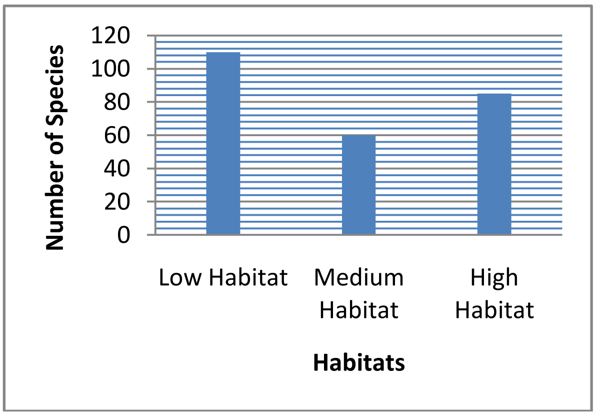

Figure 2: Results after the emigration

5. COMPARATIVE STUDY

Now we have made a comparison between the well known algorithm known as PSO (Particle Swarm Optimization). The results are shown below in table number 5 and 6.

Table 5. Shows no. of species before emigration

Low Habitat	120
Medium Habitat	66
High Habitat	92

Table 6. Shows no. of species after emigration

Low Habitat	101
Medium Habitat	55
High Habitat	82

The results show that for PSO there is high rate of emigration in comparison to new proposed approach. In case of low habitat there is approximate 9 percent difference in emigration, in case of medium habitat there is 16 percent drop in emigration and for the high habitat case there is 8 percent drop in emigration.

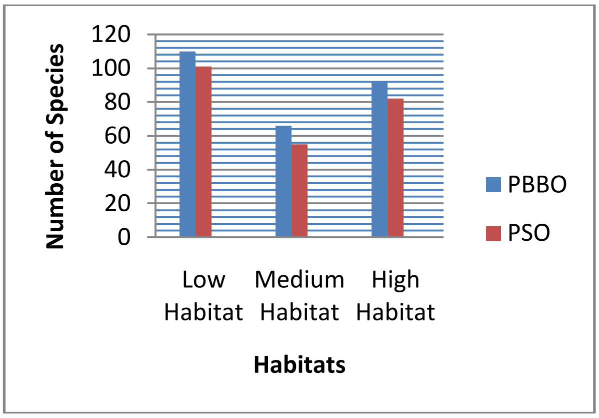

Figure 3: Results after the emigration for the PBBO and PSO.

6. CONCLUSION

In this paper, we used a new approach to measure underground water penetration using PBBO method. PBBO founds the ground water possibility for the given sample is 60%. It is better than many other methods used in the past. PBBO gives much better results than the PSO. In the future we will try to modify the algorithm so that so that better results can be further derived.

7. REFERENCES

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