

BCS2313 – ARTIFICIAL INTELLIGENCE TECHNIQUES

**Assignment 2**

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**1) Brief Introduction**

The Bees Algorithm mimics the foraging strategy of honey bees to look for the best solution to an optimization problem. These algorithms use standard evolutionary or random explorative search to locate promising locations. Then the algorithms utilize the exploitative search on the most promising locations to find the global optimum. Bee System is an improved version of the Genetic Algorithm. The main purpose of the algorithm is to improve local search while keeping the global search ability of Genetic Algorithm (Wikipedia, 2014).

**2) The origin of the bee optimization algorithm**

Table 1: Basic parameter of the Bees Algorithm (Brais, 6 November 2013)

|  |  |
| --- | --- |
| **Parameter** | **Symbols** |
| Number of scout bees in the selected patches | n |
| Number of best patches in the selected patches | m |
| Number of elite patch in the selected patches | e |
| Number of recruited bees in the elite patches | nep |
| Number of recruited bees in the non-elite patches | nsp |
| Size of neighborhood for each patch | ngh |
| Number of iteration | Maxiter |

**Pseudo-code of the basic Bees Algorithm** (Brais, 6 November 2013)

i = 0

Generate initial population.

Evaluate Fitness Value of initial population.

Sort the initial population based on the fitness result.

While i ≤ Maxiter or Fitness Valuei – Fitness Valuei – 1 ≤ Error

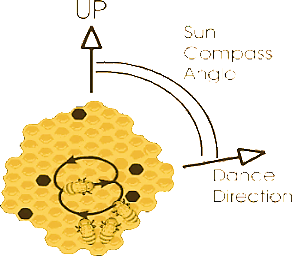
1. i = i + 1;
2. Select the elite patches and non-elite best patches for neighbourhood search.
3. Recruit the forager bees to the elite patches and non-elite best patches.
4. Evaluate the fitness value of each patch.
5. Sort the result based on their fitness.
6. Allocate the rest of the bees for global search to the non-best locations.
7. Evaluate the fitness value of non-best patches.
8. Sort the overall result based on their fitness.
9. Run the algorithm until termination criteria met.

End

**3) How the Bee Optimization Algorithm Work**

**Bees in Nature**

The Foraging Behaviour of Honey Bees

A colony of honey bees can exploit a large number of food sources in big fields and they can fly up to 11 km to exploit food sources. Flower patches with plentiful amounts of nectar or pollen that can be collected with less effort should be visited by more bees, whereas patches with less nectar or pollen should receive fewer bees. Scout bees search randomly from one patch to another. The bees who return to the hive, evaluate the different patches depending on certain quality threshold (measured as a combination of some elements, such as sugar content). They deposit their nectar or pollen goes to the “dance floor” to perform a “waggle dance”(S.Srinivasalou).

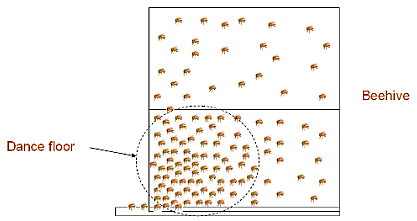


Figure 1: The Foraging Behaviour of Honey Bees

The Waggle Dance of Honey Bees

The waggle dance is named based on the wagging run (in which the dancers produce a loud buzzing sound by moving their bodies from side to side), which is used by the scout bees to communicate information about the food source to the rest of the colony. This information helps the colony to send its bees precisely. Follower bees go after the dancer bee to the patch to gather food efficiently and quickly. Bees communicate through this waggle dance which contains the following information: (Brais, 6 November 2013)

* The direction of flower patches (angle between the sun and the patch)
* The distance from the hive (duration of the dance)
* The quality rating (fitness) (frequency of the dance)

|  |
| --- |
| Flowchart of the basic Bee Algorithm: |

Figure 2: Flowchart of the basic Bee Algorithm (Brais, 6 November 2013)

**Examples of Bee Algorithm’s applications:**

* Mechanical designs like:
  + Design of welded beam
  + Design of coil spring
* Digital Filter Optimisation
* Fuzzy Control Design
* Data Clustering (solving the local optimum for K-means algorithm)
* Robot control

**Similarities between Bee Optimization Algorithm and Genetic Algorithm**

Table 2: Similarities of both algorithms (Wikipedia, 2014)

|  |  |  |
| --- | --- | --- |
| Subject | Bee Optimization Algorithm | Genetic Algorithm |
| Goal | A population of candidate solutions to look for best solution to an optimization problem | A population of candidate solutions to look for best solution to an optimization problem |
| Evaluation | Evaluation fitness of every individual in the population is required | Evaluation fitness of every individual in the population is required |

**Differences between Bee Optimization Algorithm and Genetic Algorithm**

Table 3: Differences of both algorithms (Wikipedia, 2014)

|  |  |  |
| --- | --- | --- |
| Subject | Bee Optimization Algorithm | Genetic Algorithm |
| Usage | Combinatorial optimization and continuous optimization | Natural selection and genetic recombination |
| Evolution | Neighbourhood search combined with random explorative search | Natural evolution such as inheritance, mutation, selection and crossover |

**Advantages of Bee Optimization Algorithm over GA**

Bee algorithm in optimizing numerical functions and shows better performances than GA.

1. Bee algorithm is the a best approach for the software testing which is efficient take less time & easy to implement as compare to the existing GA. It because GA have some problems which can be solved by bee algorithm optimization because GA include no memorization, non linear optimization, risk of suboptimal solution and delayed convergence.

2. Bee algorithm model based test suite optimization generates near global optimal results and it converges within less number of test runs. But, GA does not support global optimal solution even when it may be reached. So we can say that bee algorithm is the best approach in the testing environment of software (UKESAYS).

**Reference**

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