

# Survey of Bacterial Foraging Optimization Algorithm

Riya Mary Thomas

*Abstract- Bacterial Foraging Optimization Technique is used in optimization for grid computing as they get their inspirations from evolutionary idea of natural evolution. It has been broadly accepted as a global optimization algorithm of current interest for distributed optimization and control. This algorithm is inspired by the social foraging behavior of Escherichia coli. Bacterial Foraging Optimization (BFO) algorithm is a novel evolutionary computation algorithm. It is proposed based on the foraging behavior of the Escherichia coli (E. coli) bacteria living in the human intestine. The BFO algorithm is a biologically inspired computing technique. This paper presents a broad overview on the formalization of works contributed by Bacterial Foraging Optimization Algorithm to the field of grid scheduling.*

*Keywords- Bacterial Foraging Optimization Algorithm, Grid Computing, Chemotaxis*

## I. INTRODUCTION

Grid computing combines computers from multiple administrative domains to achieve a common goal to solve a particular task. Computing, most basically stated, is distributed computing taken to the next evolutionary level [1]. They are geographically distributed and interconnected through heterogeneous networks. There are some characteristics of Grid like dynamicity, independence etc which make it complex for resource scheduling in a Grid environment [2]. Due to the complexity of the grid system, the meta-heuristics approaches are proposed for scheduling the jobs in the grid systems. One of the optimization techniques is Bacterial Foraging Optimization technique. It is an optimization method of searching based on evolutionary process. BFO algorithm is a novel evolutionary computation algorithm, it is proposed based on the foraging behavior of the Escherichia coli (E. coli) bacteria live in human intestine. Natural selection tends to eliminate animals with poor foraging strategies such as locating, handling and ingesting food and favor the propagation of genes of those to achieve successful foraging [3]. The foraging behavior of E.Coli bacteria is adopted for the evolutionary computation algorithm, and it is named as Bacterial Foraging Optimization (BFO). BFO is an optimization technique based on the population search and efficient for global search method.

**Manuscript received on March 2013.**

Riya Mary Thomas, Post-Graduate Student, School of Computer Science and Technology, Karunya University, India.

## II. BACTERIAL FORAGING ALGORITHM (BFO)

Bacteria Foraging Optimization (BFO) algorithm is a new class of biologically encouraged stochastic global search technique based on mimicking the foraging behavior of E. coli bacteria. This method is used for locating, handling, and ingesting the food. During foraging, a bacterium can exhibit two different actions: tumbling or swimming [4]. The tumble action modifies the orientation of the bacterium. During swimming means the chemotaxis step, the bacterium will move in its current direction.

Chemotaxis movement is continued until a bacterium goes in the direction of positive-nutrient gradient. After a certain number of complete swims, the best half of the population undergoes the reproduction and eliminating the rest of the population. In order to escape local optima, an elimination-dispersion event is carried out where some bacteria are liquidated at random with a very small probability and the new replacements are initialized at random locations of the search space. Fig.1 shows the flow chart of the BFO algorithm.

The Chemotaxis behavior of E. coli bacteria considering the foraging behavior of E. coli, it has a common type of bacteria with a diameter of 1  $\mu m$  and a length of about 2  $\mu m$  and which under appropriate circumstances can reproduce in 20 min. It is the ability to move comes from a set of up to six rigid 100–200 rps spinning flagella, each driven by a biological motor. The E. coli bacterium alternates between running (at 10–20  $\mu m$  sec, but they cannot swim straight) and tumbling (changing the direction). When the flagellas are rotate in clockwise, they operate as propellers and hence an E.Coli may be run or tumble.

The Chemotaxis Actions are below:

(A1) If in neutral medium, the alternate tumbles and the runs  $\Rightarrow$  search.

(A2) If swimming up in a nutrient of the gradient or out of the noxious substances, swim longer (climb up nutrient gradient or down noxious gradient)  $\Rightarrow$  seek increasingly favorable environments.

(A3) If swimming down the nutrient of the gradient (or up noxious substance gradient), then search  $\Rightarrow$  to avoid unfavorable environments.

In elimination-dispersal event the gradual or unexpected changes in the local environment where a bacterium population lives it may occur due to the various reasons such as a significant local rise of temperature may kill a group of bacteria that are currently in a region with a high concentration of nutrient gradients.

Events can take place in such a method that all the bacteria in a region are killed or a group is dispersed into a new location [5].

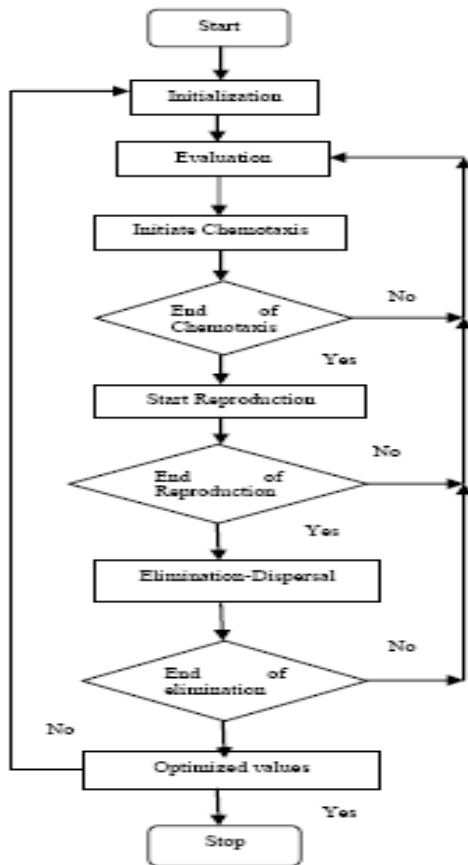


Fig.1 Flow Chart of BFO algorithm

When the task is placed in to the next available position of the task sequence, then it is assigned to a station at the same time. While it is determining the task which will be placed to any position of the task sequence, a temporary set of assignable tasks is generated according to the tasks on the previous positions of the series and the precedence relations among tasks. Then, assignable tasks of the current station within the temporary set according to their task times are listed and one of them is selected and placed to the next available position of the task sequence [6]. If any task in the temporary set is available for current station according to its task time, a new station is opened. At the end of the procedure an entire task sequence that consists of all the tasks of the problem and station assignment information of those tasks are obtained [8].

Each task has an assignment weight which is used as a precedence rule for assigning the tasks to the stations. A task is selected from the assignable tasks list according to those assignment weights. First, the assignment weights of the each task for each station are equal to cycle time value of the problem. So, the initial solutions are being generated, and then a task which is going to be placed to the next available position of the task sequence is selected arbitrarily. Then the numbers of available stations are equals to the maximum number of stations.

Single bacterium cell that undergoes the chemotaxis steps according to over a single dimensional objective function space. Since each measurement in simulated chemotaxis is updated independently of others and the only link between the measurements of the problem space are introduce the objective functions, and the analysis can be carried out on the single dimensional case, without loss of generality [7].

The bacterium lives in continuous time and at the  $t$ -th instant its position is given by  $\theta(t)$ .

### III. CONCLUSION

Bacterial Foraging Optimization Algorithm which is simple and easy to implement in order to optimize the cost for processing Client Job. BFO has been successfully applied in many areas of power system. This algorithm is very effective in giving quality solutions. It is motivated by the natural selection which contains the tends to eliminate the animals with poor foraging strategies and the favor those having successful foraging strategies.

### REFERENCES

1. Ajith Abraham, Hongbo Liu, Crina Grosan, Fatos Xhafa, Nature Inspired Meta-heuristics for Grid Single and Multi-objective Optimization Approaches, Centre for Quantifiable Quality of Service in Communication Systems.
2. R. Buyya, Economic-based distributed resource management and scheduling for grid computing, Ph.D. Thesis, Monash University, Australia, 2002.
3. Dong Hwa Kim, Ajith Abraham, Jae Hoon Cho A hybrid genetic algorithm and bacterial foraging approach for global optimization, Information Sciences 177 (2007) 3918–3937
4. Samaneh Zareh, Hamid Haj Seyedjavadi, Hossein Erfani, Grid Scheduling using Cooperative BFO Algorithm, American Journal of Scientific Research ISSN 1450-223X Issue 62(2012), pp.78-87.
5. R. Vijay, Intelligent Bacterial Foraging Optimization Technique to Economic Load Dispatch Problem, International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-2, May 2012.
6. Swagatam Das, Arijit Biswas, Sambarta Dasgupta, and Ajith Abraham, Bacterial Foraging Optimization Algorithm: Theoretical Foundations, Analysis, and Applications.
7. Sastry. V.R.S. Gollapudi, Dr. Shyam.S.Pattnaik1,Dr.O.P.Bajapai,Smt. Swapna Devi, K.M.Bakwad and Patra.K Pradyumna, Intelligent Bacterial Foraging Optimization Technique to Calculate Resonant Frequency of RMA, International Journal of Microwave and Optical Technology, Vol.4, No.2, March 2009.
8. W. J. Tang, Q. H. Wu, *Senior Member, IEEE*, and J. R. Saunders, Bacterial Foraging Algorithm For Dynamic Environments, IEEE Congress on Evolutionary Computation Sheraton Vancouver Wall Centre Hotel, Vancouver, BC, Canada July 16-21, 2006.

### AUTHORS PROFILE



**Riya Mary Thomas**, pursuing her M.Tech in Computer Science and Engineering from the department of Computer Science in Karunya University. Received her B.E in 2011 from Nandha College of Engineering under Anna University.