



# Integration of Bacteria Foraging Optimization and Case Base Reasoning for Ground Water Possibility Detection

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## ABSTRACT

Bacterial Foraging Optimization (BFO) is a population-based numerical optimization algorithm. This technique is proposed by K.M. Passino in 2002 to handle complex problems of the real world. Case-based reasoning is a unique platform of concepts and techniques that touch upon some of the basic issues concerning to knowledge representation, reasoning and learning from experience. In this work, we have integrated Bacteria Foraging Optimization with Case Based Reasoning to detect ground water possibility in a given area. An algorithm has been proposed in this work. A problem case whose ground water possibility is to be determined is input to the system. BFO retrieves the best matching case from the Case Base and the ground water possibility of that Case is proposed as a solution to the problem case.

## Keywords

Bacterial Foraging Optimization, Chemotactic, Case base reasoning, Case Retrieval, Ground water possibility.

## 1. INTRODUCTION

Bacterial Foraging Optimization (BFO) is a novel optimization algorithm based on the social foraging behavior of *E. coli* bacteria. The motile bacteria such as *E. coli* and *Salmonella* propel themselves by rotating their flagella. To move forward, the flagella co-rotate clockwise and the organism “swims” (or “runs”). While a clockwise rotation of the flagellum causes the bacterium randomly “tumble” itself in a new direction and then swims again [1]. An alternation between “swim” and “tumble” enables the bacterium search for nutrients in random directions. Swimming is more frequent as the bacterium approaches a nutrient gradient. Tumbling, hence direction changes, is more frequent as the bacterium moves away from some food to search for more. Basically, bacterial chemotaxis is a complex combination of swimming and tumbling that keeps bacteria in places of higher concentration of nutrients. Bacterial chemotaxis can also be considered as the optimization process of the exploitation of known resources, and costly exploration for new, potentially more valuable resources [2].

## 2. CLASSICAL BFO ALGORITHM

The original Bacterial Foraging Optimization system consists of three principal mechanisms, namely, chemotaxis, reproduction, and elimination-dispersal. Chemotactic consists of Swim and Tumble. Each of these processes is described as follows.

## 2.1 Chemo taxis

In the original BFO, a unit walk with random direction represents a “tumble” and a unit walk with the same direction in the last step indicates a “run.” Suppose  $\theta^i(j, k, l)$  represents the bacterium at  $j$ th chemotactic,  $k$ th reproductive, and  $l$ th elimination-dispersal step.  $C(i)$  is the chemotactic step size during each run or tumble (i.e., run-length unit). Then in each computational chemotactic step, the movement of the  $i$ th bacterium can be represented as

$$\theta^i(j+1, k, l) = \theta^i(j, k, l) + C(i) \frac{\Delta(i)}{\sqrt{\Delta^T(i)\Delta(i)}} \quad \dots(1)$$

where  $\Delta(i)$  is the direction vector of the  $j$ th chemotactic step. When the bacterial movement is run,  $\Delta(i)$  is the same with the last chemotactic step; otherwise,  $\Delta(i)$  is a random vector whose elements lie in  $[-1, 1]$ . With the activity of run or tumble taken at each step of the chemotaxis process, a step fitness, denoted as  $F(i, j, k, l)$ , will be evaluated [8].

## 2.2 Reproduction

The health status of each bacterium is calculated as the sum of the step fitness during its life, that is,  $\sum_{l=1}^{N_c} F(i, j, k, l)$ , where  $N_c$  is the maximum step in a chemotaxis process. All bacteria are sorted in reverse order according to health status. In the reproduction step, only the first half of population survives and a surviving bacterium splits into two identical ones, which are then placed in the same locations. Thus, the population of bacteria keeps constant [7].

## 2.3 Elimination and Dispersal

The chemotaxis provides a basis for local search, and the reproduction process speeds up the convergence which has been simulated by the classical BFO. While to a large extent, only chemotaxis and reproduction are not enough for global optima searching. Since bacteria may get stuck around the initial positions or local optima, it is possible for the diversity of BFO to change either gradually or suddenly to eliminate the accidents of being trapped into the local optima. In BFO, the dispersion event happens after a certain number of reproduction processes. Then some bacteria are chosen, according to a preset probability  $P_{ed}$ , to be killed and moved to another position within the environment [9], [18].

# Water Of Possibility

**Wolfgang Guggemos**



**Water Of Possibility:**

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