Computer Application Of Edge Detection Of Substrate Image Considering Fuzzy Microflora Optimization Algorithm

Tao Yu
Hohhot Vocational College, Hohhot, Inner Mongolia, China, 010051
*Corresponding author e-mail: yutaoqq@126.com

Abstract. Due to the success of the study of bacterial flora algorithm, more and more scholars to simulate the natural biological phenomenon, and the research results are applied to the computer design, effectively solve the problem of large-scale optimization. Firstly, this paper introduces the optimization algorithm of microflora, and explains the application of fuzzy microflora optimization algorithm to the edge detection computer of substrate image to provide readers with reference.

1. Introduction
As a new member of the evolutionary algorithm family, microflora optimization algorithm is a swarm intelligence optimization algorithm based on biological heuristics. It has attracted the attention of many researchers at home and abroad due to its easy-to-understand natural mechanism and potential application prospects.

2. Introductions to the optimization algorithm of bacterial flora
According to Darwin's theory of biological evolution, natural selection has always tended to weed out the less viable species and preserve the more viable ones for reproduction\(^1\)\(^-\)\(^3\). In the process of biological reproduction, those species that are less able to survive are either eliminated by nature or genetically modified to be more able to survive\(^4\)\(^-\)\(^6\). They find a place in the predatory nature by improving their physiology (sense, smell, environmental adaptation, etc.) and optimizing foraging strategies (how to find more food in the shortest amount of time at the lowest cost).

2.1. Foraging Theory
The basic hypothesis of foraging theory is that animals always hope to catch more food in a short time during foraging, that is, the foraging strategy is that the greater the energy intake per unit time, the better. Adequate energy intake provides an important guarantee for activity, mating, and reproduction. In general, the foraging strategies of different organisms differ: herbivores feed relatively easily but consume a large amount of food, and carnivores feed relatively difficult but consume a small amount of food (which is high in energy). On the other hand, geography also influences animals' predation habits: at the same time, animals are also preyed upon when they play the role of predators. Animal predation is a process in which various factors affect each other and species play each other.

For most animals, the process of predation is a cyclic decision-making process: first, the predation zone is determined, and then, based on previous experience, the decision of whether to enter this area for predation is made. There are two possible scenarios after entering a feeding area. The first scenario is that there is not enough food in the area for the animal to survive, and then the animal must continue
to search for a more abundant food area. In the second case, where food is abundant, the animals can forage there, but when the food is exhausted, they must look for a new feeding area.

2.2. Foraging search strategy
In the study of animal foraging search strategy, animal foraging is divided into the following stages: first, the search and location of prey, then the attack and capture of prey, and finally the enjoyment of prey. Different species spend different amounts of time at different stages. Here we mainly discuss the predation behavior which is the dominant factor of prey search and location, and this predation behavior applies to most species of organisms. In general, there are two strategies for predation: the first is prowling, which includes the predation of tuna and eagles, which are constantly on the move in search of prey in the foraging area. The second is an ambush, such as a rattlesnake, which lurks in an area to catch passing prey. There is, of course, a class of animals that falls somewhere in between, alternating between prowling and ambushing, in what we call jumping hunting.

2.3. Introduction of bacterial colony optimization algorithm
The foraging behavior of animals reflects not only their competition for survival with other species, but also their cooperation with each other. In fact, this kind of cooperation between animals increases the chances of successful foraging, and helps to prevent the invasion of alien species. From ants and birds to schools of fish and wolves, we see signs of group foraging. It is a bionic optimization algorithm evolved from the simulation of colony foraging behavior of ants, and has been successfully applied in the engineering field (FIG. 1 is the picture of ant foraging).

Figure 1. Picture of ants foraging.

2.4. Operation of bacterial colony optimization algorithm
2.4.1. Tendency operation
During foraging, E. coli uses the force of the flagella to move forward and reverse. When e. coli is in an area rich in food, the flagella move counterclockwise to allow it to swim forward. When e. coli is in an area where food is relatively scarce, the flagella move clockwise to change direction (that is, to flip). E. coli is controlled by both forward and reverse motion to avoid harmful substances and to seek out areas rich in food for predation. In the microflora optimization algorithm, the simulation of this phenomenon is called the tendency behavior.

2.4.2. Aggregation operation
The aggregation behavior reflects the synergistic effect between bacteria, that is, bacteria attract each
other through the action of gravitational signal and advance towards the area with abundant food together. On the other hand, bacteria repel each other through repulsive signals, so that individuals can keep a certain distance from each other, which is conducive to a single bacterium to capture more food without causing vicious competition.

2.4.3. Copy operation
Darwinian biological evolution is the survival of the fittest, after a period of food search process, the foraging ability of individuals will be eliminated by nature, the remaining individuals will reproduce to maintain the same size of the population. In the microflora optimization algorithm, we call it replication behavior. In the replication operation, bacteria are sorted according to the degree of health, and the number of eliminated bacteria (i.e., bacteria with poor foraging ability) is set as $S_-=S/2$, where the total number of bacteria is Healthy bacteria (i.e., those with strong foraging ability) reproduce and produce offspring that are identical to themselves, that is, they share the same physiological characteristics. Replication ensures that the overall size of the bacteria remains the same.

2.4.4. Migration operation
Changes in the habitat of the orchid (environmental degradation or reduced food supply) may result in local death of the bacterial population or mass migration to a new foraging area. To some extent, this migration disrupts the bacteria's propensity to migrate, but it may also lead them to seek out new foraging areas. The migration behavior of bacteria enriches the foraging strategy of bacteria, which is called migration operation in the optimization algorithm.

2.5. Comparison of bacterial colony optimization algorithm and genetic algorithm
Both the microflora optimization algorithm and the genetic algorithm search for the optimal solution by simulating the biological evolution in nature. In the microflora optimization algorithm, the trend operation guarantees the local search ability of the algorithm, the replication operation improves the search efficiency of the algorithm, and the migration operation makes the algorithm have a certain global optimization ability. Similarly, in genetic algorithm, crossover operator makes it possible for a new generation of individuals to search in the local region, selection operator embodies the Darwinian principle of survival of the fittest, good individuals are preserved, and mutation operator makes the algorithm avoid premature convergence, and can find the global optimal solution.

Both the bacteriological optimization algorithm and the genetic algorithm are globally optimal random search algorithms, which do not need any gradient information in the search process, have the characteristics of group search, and have inherent parallel computing power and inherent heuristic search mechanism. Their extensibility makes them easy to be integrated with other optimization strategies. As a new member of swarm intelligence algorithm, the optimization algorithm of microflora needs to be improved. At the same time, in the algorithm research, there is no effective quantitative analysis method for the accuracy, reliability and computational complexity of the algorithm, but the successful application in the field of engineering shows that this heuristic intelligent optimization algorithm is still worth our time and effort to explore and study.

3. Application of fuzzy flora optimization algorithm to edge detection of substrate image

3.1. Selection of fitness function
In the optimization algorithm of microflora, the evolution process of the population is to determine the optimal value of individual history based on the fitness of everyone in the population, and then use the fitness function to measure the merits of the individual to reproduce the optimal bacteria, to guide the bacteria to find the optimal solution of the problem. Therefore, fitness is a marker to measure the merits and demerits of individuals in a population, and the basis for the implementation of the optimization algorithm "survival of the fittest". Therefore, it is very important to determine an appropriate fitness function. Under general conditions, for non-special models, satisfactory results can
be obtained by selecting the function of minimum value of the model as fitness function.

### 3.2. Optimization problem analysis of nonlinear model
It is well known that almost all practical systems are nonlinear systems, so it is necessary to study the nonlinear system for the application of the substrate image edge detection computer. According to different nonlinear models, the optimization effect of microflora optimization algorithm is very different, so the microflora optimization algorithm is analyzed.

### 3.3. Analysis of simulation results

| Algorithm | Average Value | Standard Deviation | Success Rate |
|-----------|--------------|--------------------|--------------|
| GA        | 33.869       | 13                 | 84           |
| GA        | 38.617       | 43                 | 56           |
| BFO       | 35.221       | 4                  |              |

### 4. Conclusion
To sum up, as a new swarm intelligence technology, microflora optimization algorithm has attracted more and more attention from scholars due to its advantages of simple algorithm structure, flexibility, strong robustness, and self-organization ability, which provides beneficial inspiration for the design of artificial intelligence processing system and algorithm.

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