Image Edge Detection Based on Ant Colony Optimization Algorithm

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ABSTRACT

Ant colony optimization (ACO) is a new heuristic algorithm which has been proven a successful technique. The article applies the ACO to the image edge detection, get edge image edge according to different neighborhood access policy through MATLAB simulation, and use the best neighborhood strategy to get detection. Compared with the traditional edge detection methods, the algorithm can effectively suppress the noise interference, retain most of the effective information of the image.

KEYWORDS

Ant Colony Algorithm, Edge Detection

1. INTRODUCTION

Image edge detection in image processing and computer vision occupies an important position (Zhang, 1999), which contains many kinds of information such as the image structure, gradation, form and so on, through extracting the information of image edge, it can greatly reduce the data quantity of image processing and have a major impact in the image character description, matching and recognition (Marr and Hildreth, 1980). Traditional edge detection algorithm using image gray value changes generate an edge, this algorithm is simple, runs faster, but the influence of the noise is significant, in the face of complex image processing the result is not ideal, so that the image detecting techniques needs further research and development (Zhang, 2009). With a variety of bionic algorithm is applied to the field of digital image processing, a variety of new image edge algorithms is appeared, including edge detection based on neural network (Grassi, 2007), edge detection based on genetic algorithm (Yutang and Lulu, 2008), etc.

1991 in Paris, France held the first European Conference on Artificial Life, the Italy scholar Dorigo M proposed the ant colony algorithm for the first time, which is the first appearance of the ant colony algorithm in people’s field of vision. At the meeting, he showed the model of the basic ant colony algorithm. In 1992, then in his doctoral thesis, the core idea of ant colony algorithm is further elaborated (Dorigo et la., 2000).
Ant colony algorithm is a new bionic algorithm. The basic principle is the ants in search of food release pheromone as information transmission, Ants in the back determine the food nearest route to food according to the pheromone signal strength (Zhang, 1999). Ant colony algorithm was first applied to the traveling salesman problem (Shi and Wang, 2008), resource quadratic assignment problem (Garret, 2006), because of its strong adaptability, better global optimization ability and robustness, ant colony optimization algorithm is applied to more and more fields after being improved by many scholars.

1.1. Description of Ant Colony Behavior

In recent years, a large number of studies indicate that the behavior of the individual ants is very simple, individual ant can do things is quite limited, but if there is a large number of ants, Then they will cooperate with each other and will be able to complete the complex tasks through a highly structured, sophisticated social organization, which is difficult to imagine. Therefore, ants are generally used in a social way, this is the result of biological evolution. The division of labor in the ant colony system is different, and the work is also different. As a kind of social insects, the communication and information transmission between them is carried out by special means of communication.

From the food source to the nest, ants in its journey through the path secret a chemical matter called pheromone, ants in the crawling process can be aware of the existence of such substances and the intensity of its distribution, and it guide their way forward, ultimately make most of the ants remove to the direction of the high intensity of the pheromone. It is showed that the individual is through the contact residues in the path of pheromone transfer to coordinate the direction of the group action, and through mutual support among groups, exchange messages to complete the task. When the number of ants gathered on a certain path reaches a certain critical quantity, there will emerge a large and orderly army of ants. When the ant come to an intersection that is not passed, it will randomly select a path forward and release the pheromone that is related to the path length. The longer the ant walking path, the more the amount of pheromone volatilization, less residue. When the back ant came to the road again, it will have a large probability to choose the path that has more pheromone, so that the formation of the positive feedback system. The amount of pheromone on the shortest path will be more and more, and the amount of pheromone on the other path will be gradually reduced along with the time, and finally the whole ant colony will come to the optimal path. Ant colony can not only choose the best path, but also can adapt to the changes of environment, when the group find the optimal path suddenly appeared obstacles, they can also quickly find the best path. Therefore, the odd ants finding the optimal path in the process of action ability is quite limited, but the entire colony using information of the group behavior reflects very high self-organization and initiative, finally, the ant colony through the collective self-catalytic behavior to find the optimal path, complete the whole process of selection.

1.2. Characteristics of Ant Colony Algorithm

Ant colony algorithm is inspired by the foraging behavior of real ants in the biological world, and a heuristic probability search algorithm is proposed. Artificial ants have a double character. On the one hand, they are the abstract individual of real ant behavior characteristics, through the observation of the foraging behavior of real ants, the key part of the extraction is assigned to the artificial ants; on the other hand, due to the design of artificial ants to solve practical engineering optimization problems, so in order to make more effective in the ant colony algorithm, artificial ants is artificially increased some characteristics that real ants do not have.

The common characteristics of artificial ants and the real ant are:

1. They are all a group of related individuals.
2. Tasks and objectives are the same.
3. They are used to communicate with the pheromone to transfer information.
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