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Studies on the Effect of Pheromone Depositions in Ant-Based Clustering

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1. Introduction

This dissertation was carried out to solve the problem in clustering by using Ant-Based Clustering algorithm which is one of the clustering research themes which have been inspired by behaviors and activities of real ant colonies in clustering corpses that have a defined method for clustering a collection of similar and dissimilar objects. Here I proposed the combination of multiple deposited pheromones concept in the basic of Ant-Based Clustering, called Multiple Pheromones in Ant-Based Clustering (MPABC). There are 2 main types of algorithms I put forward in this dissertation as MPABC with ant nest and MPABC with ant memory.

Firstly, the algorithm of MPABC as an Ant Foraging model or MPABC with ant nest, derived from the Ant foraging theory is described. Later I discussed the method without ant nest but using ant memory of the size of clusters called MPABC with ant memory.

2. Results and Discussions

There are 2 types of pheromones concept; Trailing Pheromone (TP) and Foraging Pheromone (FP) which will be used in the clustering process as described in the following;

1) The Trailing Pheromone (TP) : is the pheromone which leads to the nest or to the cluster as;

$$TP(t+1) = (1-\beta_{eva})TP(t) + \sum_{k=1}^{n} \Delta TP \qquad (1)$$

2) The Foraging Pheromone (FP) : is the pheromone which uses for searching for new food sources and explores undiscovered areas as;

$$FP(t+1) = (1-\beta_{eva})FP(t) + \sum_{k=1}^{n} \Delta FP \qquad (2)$$

where β_{eva} is the pheromone evaporation rate at the grid. ΔTP and ΔFP are the amount of Trailing Pheromone and Foraging Pheromone, dropped by an ant, respectively.

For the experimental stages, I began with the experiment of ABC with fixed nest algorithm which performs well in the case of the number of clusters which is more than the default number of 4 clusters. This method also spends the shortest time on clustering comparing with other methods. However, using fixed nest may reduce the performance in self-organization of social insects.

MPABC with ant nest algorithm performs well only if the number of clusters is not more than 4 groups, while MPABC with ant memory algorithm spends time on clustering nearly equal to MPABC with ant nest algorithm. However, MPABC with ant memory algorithm performs better than MPABC with ant nest algorithm if the number of clusters is increased. On the other hand, there is an error occurring in this algorithm when two small clusters are of the same size. However, the chance of having this problem is only 0.05% in MPABC with ant memory.

3. Conclusions

According to the experimental results that have been done, the results indicate that this proposed method of using multiple pheromones deposition concept as the algorithms of MPABC with ant nest and MPABC with ant memory can significantly reduce the clustering time of the basic algorithm of Ant-Based Clustering. For the future plan, this proposed method will be applied to solve various problems about clustering.

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