A study on the Metaheuristics
- apply biologically inspired dynamic formation to telecommunication network -

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Abstract

A Metaheuristics is a set of concepts that can be used to define heuristic methods that can be applied to a wide set of different problems. In other words, Metaheuristics can be seen as a general algorithmic framework which can be applied to different optimization problems with relatively few modifications to make them adapted to a specific problem. We apply the ant's Metaheuristics for Search and Rescue System with ETS-VIII satellite.

1. Purpose

We have started this Metaheuristics since 1997, and our paper was submitted in IEEE [1] 1998. We have recorded and observed worker ant formations, and optimized the patterns observed through mathematical analysis and approximation, in order to apply these behavior patterns to traffic management within packet communications networks. This basic research involved observation/recording of ant movements, image processing, behavior pattern analysis, mathematical analysis/approximation, the creation of a new communications algorithm, computer simulation, ROM prototyping, and proposal of a marine field test using free float buoys.

2. Metaheuristics

2.1 Assumption

We made the following assumption (A), shown in Fig.1: this indicates assumption that individual ants understand that the weight of the food is to be distributed among them, and calculate the distances and angles formed between neighboring ants.

2.2 Mathematical analysis and approximation

Since the ant behavior recorded represents a mere subset of all ant movements, not all ant behavior patterns can be analyzed. However, we believe certain mathematical analyses and approximations are feasible, based on the assumptions.
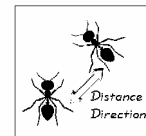

Figure 1. Mutual recognition (assumption)

2.3 Communication algorithm

Based on mathematical approximations, we developed an algorithm based on the above assumptions, substituting terminals for ants. We assumed wireless terminals using packet communication protocols. The important aspect here is the task of efficiently managing customer traffic to correspond to changes in the surrounding situation and topology.

3. Implementation

To gain an understanding of the network topology, terminals must obtain data such as signal intensity from the physical layer and GPS data from the application layer, and then seek to grasp the overall network topology by exchanging data such as information on administrative traffic. We checked our communications algorithm via computer modeling and calculated throughput for a few forms of network with a communication simulator (OPNET).

4. Considerations

METAHEURISTICS might be very useful under the environment of disaster where central control system will be broken and unable to conduct operations from the center. We intend to use this Metaheuristics for a new Search and Rescue System based on communication satellite;ETS-VIII, ROM prototyping, and proposal of a marine field test using free float buoys.

5. References

[1] I. Nakajima, S. Hama: Wireless networks based on information exchange between ants, Proceeding of the 3rd International Symposium on Multi-Dimensional Mobile Communications, IEEE Vehicular Technology Society,: pp.116-119, 1998