DISCRETE PARTICLE SWARM OPTIMIZATION SELECTING FORWARDING NODES FOR QUERY DISSEMINATION IN WIRELESS SENSOR NETWORKS

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Abstract. *In wireless sensor networks, flooding is required for the dissemination of queries and event announcements. The original flooding causes the overlap problems. In the original flooding, each sensor node receiving a broadcast message forwards it to its neighbors, resulting in a lot of collisions and duplicate messages. For dense wireless sensor networks, the impact caused by the original flooding may be overwhelming. The original flooding may result in the reduced network lifetime. Therefore, the selection of forwarding nodes for the dissemination of queries and event announcements is needed to prolong the lifetime of wireless sensor networks. In this study, we use the discrete particle swarm optimization method to select forwarding nodes for query dissemination.*
Keywords: Sensor networks, Selecting forwarding nodes, Query dissemination, Particle swarm optimization

1. Introduction

Wireless sensor networks have a wide range of applications, such as environmental monitoring, environmental control, object tracking, and precision agriculture[1]. In wireless sensor networks, flooding is required for the dissemination of queries and event announcements. The original flooding causes the overlap problems. In the original flooding, each sensor node receiving a broadcast message forwards it to its neighbors, resulting in a lot of collisions and duplicate messages. For dense wireless sensor networks, the impact caused by the original flooding may be overwhelming. The original flooding may result in the reduced network lifetime. Therefore, the selection of forwarding nodes for the dissemination of queries and event announcements is needed to prolong the lifetime of wireless sensor networks. In this study, we use the discrete particle swarm optimization method to select forwarding nodes for the dissemination of queries and event announcements. We evaluate the applicability of discrete particle swarm optimization by computer simulations and discuss its development potential. In simulation experiments, the performance of discrete particle swarm optimization is compared with that of genetic algorithm.

2. Discrete Particle Swarm Optimization

The particle swarm optimization method belongs to the category of swarm intelligence methods[2]. It was developed and first introduced as a stochastic optimization algorithm. The ideas that underlie the particle swarm optimization method are inspired not by the evolutionary mechanisms encountered in natural selection, but rather by the social behavior of flocking organisms, such as swarms of birds and fish schools. The particle swarm optimization method can directly handle the variables of continuous type[3]. The discrete particle swarm optimization method is an improved algorithm proposed for combination optimization problems[4].

3. Experimental Results

In the selection of forwarding nodes for the dissemination of queries and event announcements, the network topology information is first collected by a sink node. Forwarding nodes are selected by applying the discrete particle swarm optimization method to a combination optimization problem based on the topology information. The conditions of simulation and the values for the parameters of Discrete Particle Swarm Optimization (DPSO) and Genetic Algorithm (GA) are shown in Table 1 and Table 2. A global optimum solution on forwarding nodes is illustrated in Fig.1. Experimental results are reported in Fig.2, Fig.3, and Fig.4. By using the discrete particle swarm optimization method, a global optimum solution on forwarding nodes was obtained within 200 iterations.

Table 1 Conditions of simulation

Simulation size	100*m*×100*m*
The Number of sensor nodes	73
Range of radio wave	25*m*

Table 2 Settings for DPSO and GA parameters

DPSO	GA
The number of particle: 30	The number of individual: 30
ω, c1, c2: 1.0, 2.1, 0.8	Mutation rate: 5%

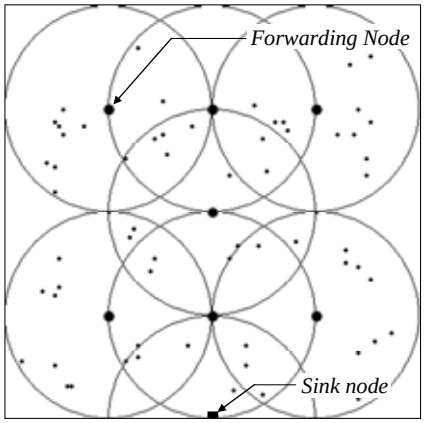

Fig.1 Simulation configuration

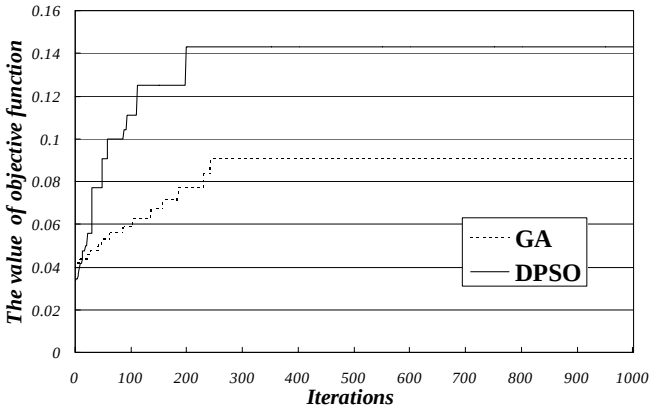

Fig.2 Experimental results

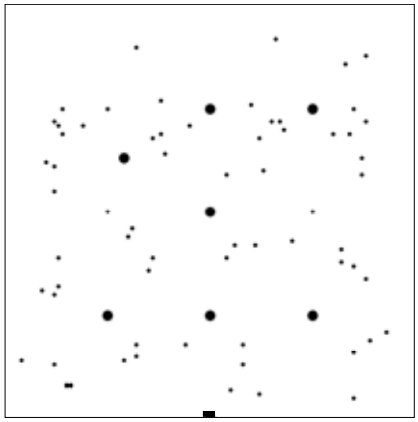

Fig.3 Forwarding nodes selected by DPSO

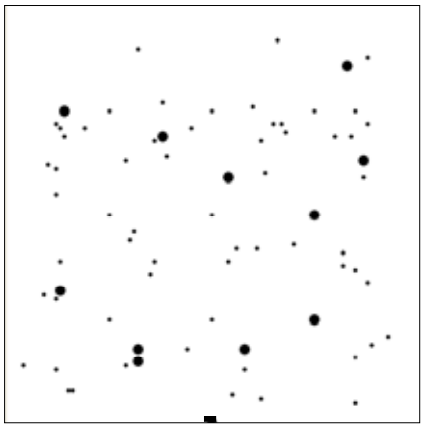

Fig.4 Forwarding nodes selected by GA

4. Conclusions

In this study, the discrete particle swarm optimization method has been used for selecting forwarding nodes for the dissemination of queries and event announcements. Through experimental results, it has been confirmed that the discrete particle swarm optimization method has the development potential as a promising method selecting forwarding nodes for the dissemination of queries and event announcements within an allowable computation time.

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