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Multi-target and Fuzzy Cloud computing Resource Scheduling

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Abstract. This paper combined with jamming time-window, jamming efficiency ratio, jamming satisfaction, established multi-target fuzzy cloud computing jamming resource scheduling model with time-window, through the simulation. The results showed, the improved firefly algorithm can preferably allocate the resources in cloud computing model, the effect of prediction model time is more close to actual time, can efficiently limit the possibility of falling into local convergence, the optimal solution's time of objective function value is shorten which meet the user's needs more.

Keywords: Multi-target, fuzzy cloud computing, Time-window, Resource scheduling

1 Introduction

In the era of information war, electronic monitoring system gradually to digital, broadband, high power, high precision, interference integration of digitalizing broadband active phased array direction [1,2]. Such as the U.S. navy shipboard advanced multi-function radio frequency system (AMRFS), in which the function of radar, electronic monitoring and communication are integrated [3-5]. But now, the study on the integration of the system resource scheduling is less, this essay try to find an effective control method to solve the resource scheduling of electronic monitoring integrated system.

2 Electronic Monitoring Integrated System

Jamming power and the gain of antenna are related to factors such as the quantity of sub-array and the distance of sub-array, the jamming power P_j and the gain of antenna G_j are as follows:

$$P_j = P_S N_x N_y \tag{1}$$

According to the AMRFC, there are 1024 array units, which are double polarized and arranged by 32 x 32 in square. At first, array units are divided into 4 sub-array in 4

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quadrant (quadrant of Ⅰ, Ⅱ, Ⅲ, Ⅳ), again each quadrant (sub-array) is divided into 4 basic sub-array, which is consist of 64 fundamental array units in the phalanx of 8 x 8 [7].

Assuming that $P_s = 4w$, $\eta_A = 1$, θ is 0°-45°, then we can calculate the power and the gain of different quantity of basic sub-array according to the formula (1) and (3), as shown in Figure 1, Figure 2.

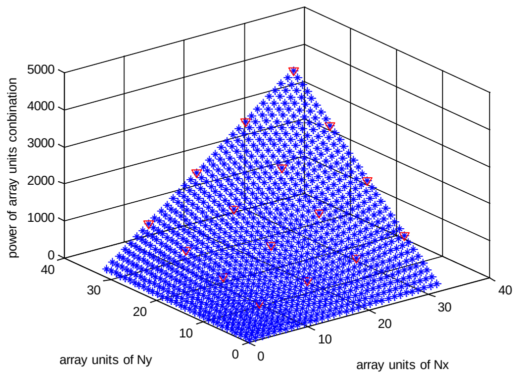

Fig. 1. Power of sub-array

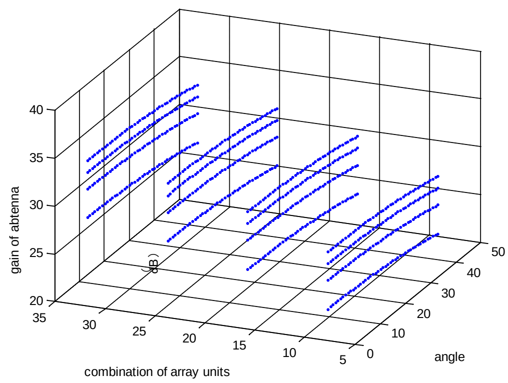

Fig. 2. Antenna gain of sub-array

3 Analysis of Multi-target Interference

Assuming that the target i fly to ships straightly, the speed is v_i, the start time and distance of interfere is T_{is} and R_{is} respectively, the estimated end time and distance of interfere is T_{ie} and R_{ie} respectively. Target jamming time-window is $[T_{is}, T_{ie}]$, namely the interference duration is T_{icx}:

$$T_{icx} = T_{ie} - T_{is} \tag{2}$$

R_{it} is the distance between the target i and the ship changed with the time t as follows:

$$R_{it} = R_{is} - v_i \times t \tag{3}$$

$(N_{ix}, N_{iy})_t$ is the quantity of array units needed at the time t for interference to target i:

$$(N_{ix} N_{iy})_t = \left(\frac{K_{ij\Sigma} P_{it} G_{it} \sigma_i}{4\pi (R_{is} - v_i \times t)^2} \bullet \frac{L_d}{L_j \gamma_j K_f} \frac{1}{P_s \pi \eta_A \cos\theta_i} \right)^{1/2} \tag{4}$$

Assume that each basic sub-array is composed of 64 array units, then the quantity of basic sub-array $Z_i(t)$ needed at the time t for interference to target i can be calculated as follows:

$$Z_i(t) = \lceil (N_{ix}, N_{iy})_t / 64 \rceil \tag{5}$$

$Z_i(t)$ is positive (up) integer

Strategy of sub-arrays' allocation. Assume that the quantity of targets need to be interfered at the same time is n, $Z_{\max}$ is maximum interference power provided by array, the quantity of basic sub-array $Z_i(t)$ needed of multi-target interfered at the same time is:

$$Z(t) = \sum_{i=1}^{n} Z_i(t) \quad s.t.: \ Z(t) \le Z_{\max} \tag{6}$$

Table 1. Sub-tasks and resources table

The subtasks	resources	Running time	Running costs	Total resources
n_1	m_1	$t(n_1,m_1)$	$\cos t(n_1,m_1)$	$Sm=\sum_{i=1}^{n} m_i$
n_2	m_2	$t(n_2,m_2)$	$\cos t(n_2,m_2)$	
………	………	……….	……….	
n_n	m_n	$t(n_i,m_j)$	$\cos t(n_i,m_j)$	

In cloud computing environment, the mostly used model is Map/Reduce, this model operates well in large-scale parallel task. Especially in cloud computing environment, it needs to processes each cloud user's resource number, time, network channel fee, etc. in time. The currently related task scheduling algorithm focuses on the needs of overall task, considers less about the cloud user's complementing time, which led to

unreasonable in time and resources distribution for the users when multiple tasks operates. Supposes cloud client's tasks of cloud computing as table 1:
a) Divides large-scaled task into relatively small tasks, divides in average, the sub-tasks' operating time are similar.
b) The number of resource distribution offers enough for sub-tasks.
c) Reasonable defines sub-task occupies resources time.

4 Intelligence Firefly Algorithm

Intelligence firefly algorithm, proposed by KRISHNANAD, etc. in 2005, it's a new intelligence swarm optimal algorithm, this algorithm is wildly used in producing and scheduling, its simulated the search and optimize process to the firefly's attraction and migration, measured the advantages and disadvantages of the individual's position by solving the objective function. In this algorithm, each intelligence firefly distributes in the declaration space of objective function, this intelligence firefly has its field of view and carries fluorescent powder, the brightness of fireflies is related to its position and the fitness value of objective function, the brighter position shows the firefly there has pretty objective value and it can attract more fireflies to move towards this direction, as each firefly has its own range of view, the range can be affected by the neighbor fireflies, when the number of firefly becomes fewer, the range of view is larger and attracts more fireflies. When the fireflies are more, the range of view becomes smaller. But at last the position which most of the fireflies in is the optimal solution position.

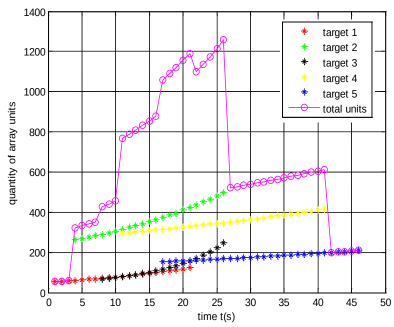

Fig. 5. Relationship of target and basic units demanded

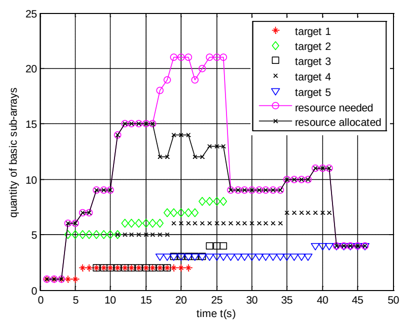

Fig.6. Relationship of target and sub-array demanded

To demonstrate interference of resource scheduling in the case of insufficient resources, threat grade of all threat targets were set to 1 (highest grade), targets from the many different directions (the value of targets interval is 10 degree), time-windows of targets overlapped severely, the competition of limited jamming resources is fierce. Through simulation and calculation, the relationship between targets and array units demanded as shown in Figure 3, and the relationship between targets and the basic sub-arrays demanded as shown in Figure 4.

5 Conclusion

On the basis of giving out the resource allocate strategy of array, combined with jamming equation and target jamming time-window, for the problem of multi-target interference: the quantity of incoming target and the stages of interference are uncertain. This paper established jamming resource scheduling model based on multi-target fuzzy cloud computing with time-window. To allocate jamming resources of the electronic monitoring integrated system, according to two indexes, jamming satisfaction and jamming efficiency, to optimize resource scheduling with the maximum jamming satisfaction and the optimal jamming efficiency.

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