Simulation Analysis for intelligent scheduling model of large tasks

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Keywords: time-sharing task load; workload; scheduling;

Abstract. The reasonable scheduling of tasks can maximize the conservation of resources, improve the utilization rate of work resources. The current task scheduling regards task conflict have already occurred as the prerequisite, and passive coping strategy is adopted, the model is built based on the prerequisite of existing conflict, The model only consider mobility and instability conditions between tasks in the conflicting state, without fully considering conflict probability factors of different time task conflicts before conflicting happens, a passive scheduling way is utilized to solve the problem, the defect is apparent. The complex workflow scheduling method based on time-sharing task load distribution statistics prediction is put forward. The data related to task load in different period is collected for validity evaluation and prediction, and then determine task form, load and time interval need to be dispatched, in considering the time factor, the work task scheduling is completed to optimize scheduling model. The experimental results show that, by using the optimization algorithm for tasks scheduling, can greatly save the cost, improve work efficiency.

1 Introduction

With the continually accelerating of office automation process, intelligent work scheduling scheme plays a more and more important role in people's work. Task scheduling as the core system of large enterprises, has a vital status in reducing operation costs, conserving resources, and submitting job satisfaction, therefore, complex workflow scheduling has become a hot topic in the work need to be researched [1,2]. At this stage, the task scheduling methods mainly include scheduling method based on artificial fish swarm algorithm, the scheduling method based on ant colony algorithm and scheduling method based on genetic algorithm. Among them, the most commonly used is the scheduling method based on ant colony algorithm. Due to the task scheduling method plays a core role which cannot be replaced in office automation, has very broad prospects for development, it attracts attention of many related experts, and has become one of the hot research issues in related field[3-5].

The current task scheduling regards task conflict have already occurred as the prerequisite, and passive coping strategy is adopted, the model is built based on the prerequisite of existing conflict, The model only consider mobility and instability conditions between tasks in the conflicting state, without fully considering conflict probability factors of different time task conflicts before conflicting happens, a passive scheduling way is utilized to solve the problem, the defect is apparent[6-8].

2 Research on optimization algorithm of complex task scheduling

2.1 Analysis of task load feature

The characteristics of task load can be described with unbalanced property of time, direction and the site distribution:

(1) unbalanced property of task load time.

The distribution of task load in each hour of a day is not balanced. Generally time unbalanced coefficient (K_t) can be used to describe, and the ratio of task load of j-th hour and average task load of an hour of work task operation time can be calculated. That is:

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$$K_{tj} = \frac{Q_j}{Q_h} \quad (11)$$

In the above formula, K_{tj} is unbalanced coefficient of j -th hour of task time, Q_j is the task load of j -th hour of task time, Q_h is the average work load of an hour.

(2) unbalance property of task load quantity.

In the operation of work task, the number of tasks at different location is not balanced at the same time. Generally, unbalance coefficient (K_s) is utilized to describe, and the ratio of some work load and average work load in unit time can be calculated. That is:

$$K_{si} = \frac{Q_{si}}{Q_n} \quad (12)$$

In the formula, K_{si} is the uneven coefficient of bus line time-sharing section, Q_{si} is the quantity of tasks at i -th section of bus line in unit time, Q_n is average section task load of bus route unit time.

(3) unbalance property of the direction of task load.

Work tasks can be divided into upstream and downstream task load, unbalance characteristics appears at the same time. The unbalance coefficient of the direction is (K_a), and can be calculated by the ratio of the average task load use in unit time. That is:

$$K_a = \frac{\max(A_{\max}^{上}、A_{\max}^{下})}{Q_n} \quad (13)$$

In the formula, K_a is the unbalanced coefficient of each direction, $A_{\max}^{上}、A_{\max}^{下}$ is the maximum task load downstream and upstream, Q_n is the average task load of two-way in unit time.

(4) unbalance property of tasks sites.

The work load at each site in the work is not balanced, can generally use the site unbalanced coefficient K_i to describe, and can be calculated by the ratio of task load in i -th station and average task load of this site. That is:

$$K_i = \frac{Q_i}{Q_v} \quad (14)$$

In the above formula, K_i is unbalance coefficient of each site in work, Q_i is task load of upstream and downstream i site in work task time, Q_v is the average distributed task load of each site in unit time.

2.2 The prediction of task quantity

The work IC card quantity is used for stating the number of employees, to establish work probability matrix of the site staff, so as to obtain task number. The distance distribution of work place is in normal distribution, the work completion probability along with the quantity of passed sites follow Poisson distribution characteristics. The completion probability can be calculated using the formula:

$$F_{i,j} = \frac{e^{-\lambda}\lambda^{(j-i)}}{(j-i)!} \quad (15)$$

In the above formula, $F_{i,j}$ represents the probability of i site work began while the j site work completed, λ indicates the average number of sites passed by tasks, if the number of the sites after the site i is less than the number of sites of average task workload, then $\lambda = m - i, m$ is the number of one-way work site.

In addition, the attractive intensity of site also need to be acquired, each site attract weights of task is W_i , S_i is the attracting scope of i site:

$$W_i = \frac{S_i}{\sum_{i=1}^{n} S_i} \tag{16}$$

A site work completion probability matrix is related to sites attract intensity, therefore, the following can be known:

$$P_{ij} = \begin{cases} \dfrac{F_{ij} \times W_j}{\sum_{j=i+1}^{n} F_{ij} \times W_j}, i < j \\ 0, i \geq j \end{cases} \tag{17}$$

Based on the formula, complete work probability matrix can be obtained, and put into the following formula to obtain the number of employees in the site:

$$DP(i) = \sum_{i=1}^{j-1} (BP(i) \times P_{ij}), i = 1, 2, ..., n \tag{18}$$

the task quantity is:

$$V_j = \sum_{i=1}^{n} \left[\frac{BP(i) - DP(i)}{\mu} \right] \tag{19}$$

Among them, V_j represents the task quantity of the j section, $BP(i)$ is the number of employees participating in the work in i station, $DP(i)$ is the number of employees complete work in i station , μ is the work card rate.

2.3 Determine the task scheduling form

Task scheduling form is generally divided into the total scheduling, section scheduling and fast scheduling. According to the distribution characteristics of workload to decide task scheduling form.

By the characteristics of task quantity that can know the unbalance coefficient of the road $K_{si} = \frac{Q_{si}}{Q_n}$, the difference of task quantity can be described as:

$$\Delta Q_{si} = Q_{si} - Q_n \tag{20}$$

when $K_{si} > K_{s0}$ (data range is1.2~1.5), or $\Delta Q_{si} \geq (2 \sim 4) q^0$, it needs to increase worker, where, q^0 is the number of project personnel， r^0 is load factor.

By the characteristics of task quantity that can know the unbalance coefficient is as follows:

$$K_{\mathrm{i}} = \frac{Q_{\mathrm{i}}}{Q_{\mathrm{v}}} \tag{21}$$

For the task site of $K_{\mathrm{i}} \geq K^0$ (range 1.4~2.0), adding fast scheduling can be considered, to ease the congestion of task, improve the efficiency.

3 Experimental results and analysis

In order to verify the effectiveness and superiority of the optimization algorithm, there is the need for an experiment. In the process of the experiment, selecting number 10 cross task as the experimental samples, the sample data are as follows:

Table 1 experimental samples data

NO.	label of task route
1	Route 1
2	Route 2
3	Route 25
4	Route 28
5	Route 37
6	Route 39
7	Route 56
8	Route 73
9	Route 79
10	Route 125

Randomly selecting samples to do comparison with traditional algorithm and optimization algorithm. Experiment is 10 times. The job satisfaction as shown in the following figure 1 respectively:

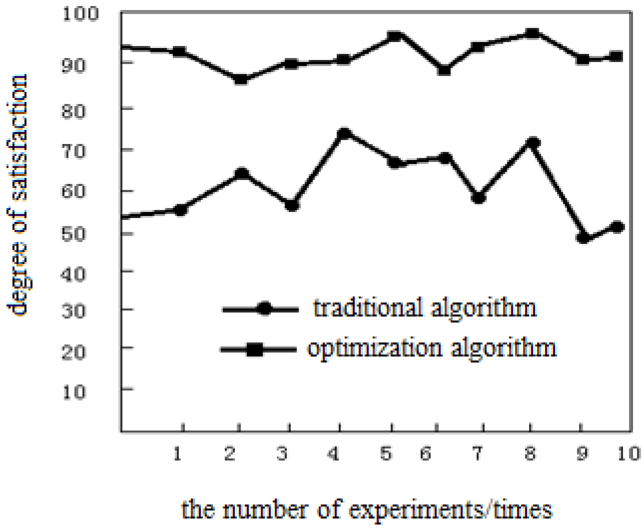

Fig. 1 the job satisfaction of different algorithms

According to the experiment results, the optimization algorithm used for task scheduling has greater satisfaction than the traditional scheduling algorithm.

In the experimental process, energy utilization rate of scheduling obtained with different algorithms can be shown as below:

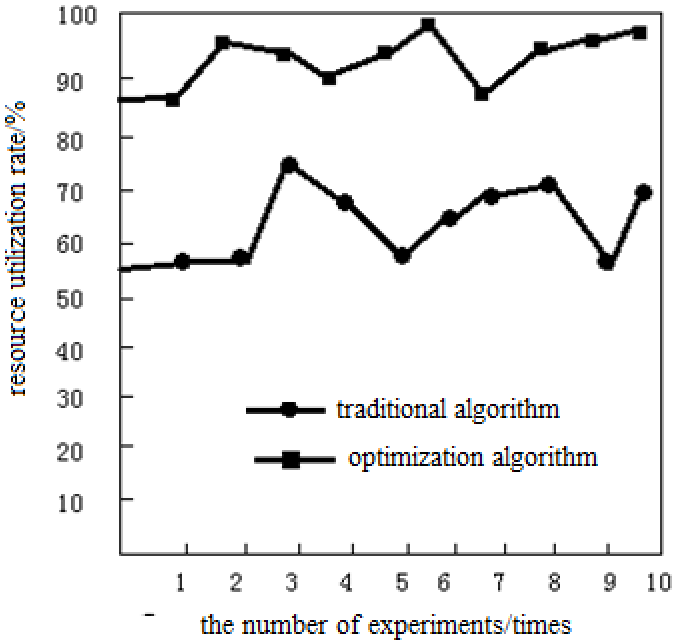

Figure 2 resource utilization rate of different algorithms

According to the experiment, by using the optimization algorithm for tasks scheduling, resource utilization rate is higher than the traditional algorithm.

Analyzing relevant data of the experiment, we can get the following experimental results as shown in Table 2, table 3:

Table 2 Comparison results of passenger satisfaction of different algorithms

The number of experiments (times)	Traditional algorithm (%)	Optimization algorithm (%)
1	58	92
2	63	86
3	59	89
4	72	91
5	65	93
6	67	88
7	58	92
8	71	95
9	49	86
10	52	88

Table 3 Comparison results of resource utilization ratio of different algorithms

The number of experiments (times)	Traditional algorithm (%)	Optimization algorithm (%)
1	56	88
2	58	96
3	72	93
4	65	90
5	59	95
6	63	99
7	67	89
8	70	91
9	55	97
10	68	98

On the basis of the above experiments, by using the improved algorithm for task scheduling, can avoid the defects of the traditional task scheduling algorithm, achieved satisfactory results.

4 Conclusions

Aiming at the detect caused by the traditional task scheduling algorithm, like waste of task resources and unreasonable scheduling produced by not fully considering time-sharing task load distribution, the scheduling method based on time-sharing task load distribution statistics prediction is put forward. The experimental results show that, the task scheduling optimization algorithm considering time-sharing task load distribution can greatly improve the load factor of tasks, realizes the optimal scheme of task scheduling, and has great superiority.

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