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## Scheduling analysis of intelligent machining system based on combined weights

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# Scheduling analysis of intelligent machining system based on combined weights

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**Abstract.** Weight is an important index system in the evaluation system. In order to improve the objectivity and accuracy of weight calculation in the model of intelligent machining system, we adopt the method of combining subjective with objective, calculate two groups of weights by using entropy weight method and expert ranking method, and then determine the combined weights by combining weights method to obtain a combination of both. The reasonable weight of subjective and objective analysis is used to obtain the intelligent scheduling model of Rail Guided Vehicle in intelligent machining system.

**Key words.** The entropy weight method Expert ranking method Combined weights.

## 1. Introduction

In recent years, intelligent processing systems have been widely used in logistics, medicine, glass fiber, furniture and other industries [1]. The integrated equipment with automatic processing system as the core tends to be diversified, and the technical performance and level are constantly improving. Rail Guided Vehicle is a combination of various high and new technologies. It can be used as an auxiliary system of intelligent machining system or an independent conveying system. It is widely used because of its fast conveying speed, high degree of automation and flexible field. The object of this paper is linear orbit. Let's analyze the factors that affect the weight calculation.

## 2. Combined weight model based on entropy weight method and expert ranking method

In the intelligent scheduling model of industrial production, there are three factors influencing the scheduling of Rail Guided Vehicle: the current distance difference between Computer Number Controller and Rail Guided Vehicle that emits the demand signal, the time taken to execute the loading and unloading operation, and the degree of offset from the center. From this we can draw that  $P = k_1 d_x + k_2 t_c + k_3 d_p$ .

By searching the data of the relevant intelligent RGV machining system, it is found that the distance between the two is usually large, and the moving speed of the RGV is slower. The moving time of the RGV is longer than that of the even CNC and the odd CNC. We have made reasonable assumptions on some situations and analyzed the weights between factors.



### 2.1. Expert ranking method

Expert System (ES) is an artificial intelligence computer program that can solve complex problems by applying a large number of expert knowledge and reasoning methods in some specific fields [2]. As a branch of artificial intelligence, expert system aims to simulate the reasoning and thinking process of human experts. Generally, the knowledge and experience of the domain experts are deposited in the computer. The system infers the facts of input and makes judgments and decisions.

We use computer software to make the system qualitative analysis of these factors and give the corresponding evaluation results. At the same time, multiple sets of different types of RGV data are given to the system, and multiple results are obtained. The expert ranking method is used to solve complex results.

The evaluation object involves  $n$  factors (that is,  $n$  evaluation indicators), so that the system ranks  $m$  groups of data according to their importance, and the number of each factor ranked is called the rank of the factor. The rank sum of the  $m$  results is called the rank sum of the factor, expressed in the letter  $R$ . The rank sum of the  $j$  factors is expressed by  $R_j$ . If  $K$  is used to represent the weight of the  $j$  factor, the formula of weight assignment is

$$k_j = \frac{2[m(1+n) - R_j]}{[mn(1+n)]} \quad (1)$$

The formula of weight can be obtained that  $P = k_1 d_x + k_2 t_c + k_3 d_p$ .

### 2.2. Entropy weight method

In the last section, we get the correlation weight by expert system and expert ranking method, and then we use entropy weight method [3]. to calculate.

1) Get sample data, which contains  $p$  indicators and  $n$  samples. The data matrix is that:

$$R = (x_{kj})_{np} \quad (k = 1, 2, \dots, n, j = 1, 2, 3) \quad (2)$$

2) Data normalization

The indicators selected are all positive indicators, that is, the higher the index value, the higher the corresponding priority. Before calculating the comprehensive index, we should standardize the positive indicators. The specific methods are as follows:

$$p_{jk} = \frac{x_{jk}}{\sum_{k=1}^n x'_{kj}} \quad (k = 1, \dots, n, j = 1, 2, 3) \quad (3)$$

3) Calculate the entropy

$$e_j = -K \sum_{k=1}^n p_{kj} \ln(p_{kj}) \quad (4)$$

4) Calculate the redundancy of task entropy

$$d_j = 1 - e_j \quad (5)$$

5) Calculate the weight of each indicator:

$$r_j = \frac{d_j}{\sum_{j=1}^2 d_j} \quad (6)$$

6) Calculate the comprehensive priority:

$$P = \lambda_1 x_{k1} + \lambda_2 x_{k2} + \lambda_3 x_{k3} \quad (7)$$

### 2.3. Combinatorial weight

Weight, as an important part of the evaluation model, plays an irreplaceable role in the evaluation process. According to the different weighting methods of evaluation indexes, it can be divided into two categories: subjective weighting method and objective weighting method [4]. In the above two sections, we use the expert ranking method and entropy weight method to get the weight respectively. Next, we use the combination weight method to analyze and judge the two results comprehensively, and get the final result. It effectively improves the accuracy of weights.

The weight obtained by expert ranking method is:  $W_1 = [\omega_{11}, \omega_{12}, \omega_{13}, \dots, \omega_{1t}]$ ,

$$0 \leq \omega_{kt} \leq 1 \quad \sum_{k=1}^t \omega_{1k} = 1 \quad k = 1, 2, \dots, t.$$

The weight obtained by using entropy weight method is:  $W_2 = [\omega_{21}, \omega_{22}, \omega_{23}, \dots, \omega_{2t}]$ ,

$$0 \leq \omega_k \leq 1 \quad \sum_{k=1}^t \omega_{2k} = 1 \quad k = 1, 2, \dots, t.$$

Then, we can obtain the combined weight:

$$W = a W_1 + b W_2 \quad 0 < W \leq 1, a + b = 1 \quad (8)$$

Next, we calculate the values of a and B through the weight expectation values of the two weights:

$$\begin{cases} E(\omega_{1k}) = \sum_{j=1}^n \omega_{jk}, 1 \leq k \leq m \\ E(\omega_{2k}) = \sum_{s=n+1}^p \omega_{sk}, 1 \leq k \leq m \end{cases} \quad (9)$$

We can obtain that:

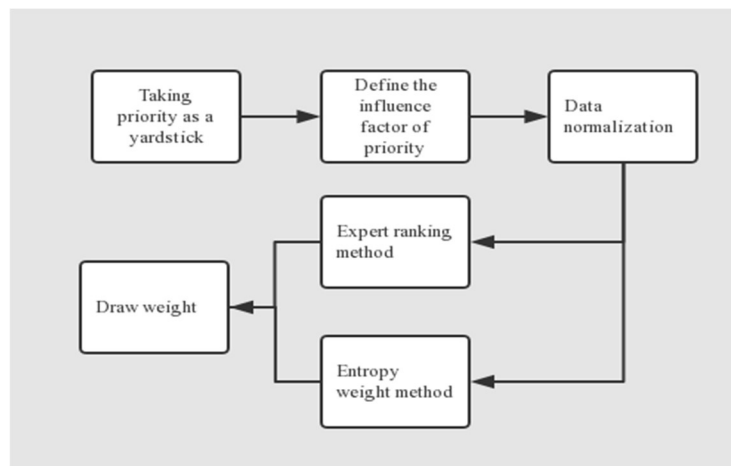
$$\begin{cases} a_k = \frac{E(\omega_{1t})}{E(\omega_{1t}) + E(\omega_{2t})} \\ b_k = \frac{E(\omega_{2t})}{E(\omega_{1t}) + E(\omega_{2t})} \end{cases} \quad (10)$$

$$\begin{cases} a = \frac{\sum_{k=1}^m a_k}{\sum_{k=1}^m a_k + \sum_{k=1}^m b_k} \\ b = \frac{\sum_{k=1}^m b_k}{\sum_{k=1}^m a_k + \sum_{k=1}^m b_k} \end{cases} \quad (11)$$

Through the above formula, we have solved the combined weight.

### 3. Empirical research

The following is our calculation process.



**Figure 1.** Calculation process

The following is our calculation result. The data used in this paper is a straight-line track parameter [5].

**Table 1.** Three Scheme comparing.

| weight coefficient | Expert ranking method | Entropy weight method | Combinatorial weight method |
|--------------------|-----------------------|-----------------------|-----------------------------|
| $k_1$              | 0.674                 | 0.663                 | 0.607                       |
| $k_2$              | 0.101                 | 0.144                 | 0.168                       |
| $k_3$              | 0.225                 | 0.192                 | 0.225                       |

#### 4. Conclusion

This paper combines the characteristics of expert ranking method and entropy weight method in the process of determining weights, and combines the two methods. It not only gives full play to the characteristics of the entropy weight method in describing the underlying indicators objectively, but also corrects the defects of its weak description of the characteristics of high-level indicators by improving the expert ranking method, so as to determine the weights in the comprehensive evaluation system. It provides a new idea and more accurate weight data for our intelligent machining scheduling system.

This paper mainly studies the weights of the factors affecting Rail Guided Vehicle in the automatic dispatching model of factories. It mainly analyzes and calculates the weights by mathematical methods. Finally, it verifies the method of combined weights by the actual data.

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