OPTIMAL SELECTION OF CUTTING LENGTH OF BARS BY GENETIC ALGORITHMS

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ABSTRACT

The optimal selection method of cutting lengths of bars by genetic algorithms is explained. When the raw bars of various length are cut into finished products of predetermined various length, the combination of cutting lengths in a raw bar is determined by genetic algorithms to achieve the minimum length of scrap produced, at the same time, keeping the amount of each size of products in accordance with the order of customers at the end of production.

OUTLINE OF SYSTEMS

The purpose of the system is to determine the combination of cutting length in a raw bar, hence the chromosome of each individual which corresponds to a raw bar consists of genes expressing the number of cuts to each finished bar length.

To make the length of scrap minimum and keep balance among the number of finished bars, a fitness function which is one of the most important factors is defined as follows:

$$F(k) = a(k)F_1(k) + b(k)F_2(k)$$

The function $F_1(k)$ is to make the scrap length minimum and reduced as follows:

$$F_1(k) = f_1(\Delta L(k))$$

$$\Delta L(k) = L(k) - \sum_{i=1}^{N} L_i n_i(k)$$

where, $L(k)$ is the length of each raw bar, N is the number of different kind of finished bar lengths, L_i and $n_i(k)$ are the length and the number of cuts for i-th finished bar length. Hence $\Delta L(k)$ stands for the length of each scrap and should be non-negative. In order to make the scrap length minimum, we determined the function $f_1(x)$ as a non-negative decreasing function whose value becomes maximum at $x = 0$ and is always non-negative in the operating range.

The function $F_2(k)$ is to keep balance among the number of finished bars and is determined as follows:

$$F_2(k) = \sum_{i=1}^{N} f_2(\Delta r_i(k))$$

$$\Delta r_i(k) = \frac{r_i}{\sum_{j=1}^{N} r_j} - \frac{p_i(k) + n_i(k)}{\sum_{j=1}^{N}(p_j(k) + n_j(k))}$$

where, r_i stands for the target of production ratios among the finished bars and p_i is the summarized number of the finished bars produced until this time for each size. Hence $\Delta r_i(k)$ is the deviation of production ratios from the object values. The function $f_2(*)$ is similar to $f_2(*)$.

CONCLUSIONS

We can get the genetic algorithms which can solve two optimal requirements of minimum scrap length, while keeping balance among the amounts of finished bars and we have confirmed their performance by simulation studies.

REFERENCES

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