Computing, Performance and Communication Systems (2021) Vol. 5: 1-4
Clausius Scientific Press, Canada

DOI: 10.23977/cpcs.2021.51001
ISSN 2371-8889

Study on optimal temperature furnace curve based on wavelet transform algorithm

Zuolin Wang*, Zhanwei Yin, Wenshuo Ni

Department of Shandong University of science and technology, Shandong, China

*Corresponding author: 534396942@qq.com

Keywords: nonlinear programming, Wavelet transform algorithm

Abstract: Based on the equation of furnace temperature curve, the objective function is established by integral, and then the constraint condition is established according to the process boundary. Wavelet transform algorithm to finally, finally the optimum furnace temperature curve, can draw 185 DHS C (small temperature range 1 ~ 5), 208 DHS C (small temperature zone 6), 240 DHS C (temperature range of small 7), 252 DHS C (temperature range of small 8 ~ 9), the corresponding area of 968.24 cm2, again USES the wavelet transform algorithm, and the function such as secondary derivative method, first to second derivative of furnace temperature curve function, make the secondary derived function is obtained through origin of coordinates. Then the constraint conditions and objective function were established. Finally, when the optimal furnace temperature curve was reached, 183°C (small temperature range 1~5), 205°C (small temperature range 6), 241°C (small temperature range 7) and 253°C (small temperature range 8~9), the corresponding area was 1096.38cm2.

1. Introduction

There are several small temperature zones in the backweld furnace, which can be divided into four large temperature zones: preheating zone, constant temperature zone, reflux zone and cooling zone. The two sides of the circuit board are placed on the conveyor belt at a uniform speed into the furnace for heating and welding.

There are 11 small temperature zones, front and back of the furnace in a reweld furnace. The length of each small temperature zone is 30.5cm, and there is a 5cm gap between the adjacent small temperature zones. The length of the front and back of the furnace are both 25 cm.

After the rewelding furnace is started, the air temperature in the furnace will reach stability in a short time. After that, the rewelding furnace can carry out welding work. There is no special temperature control for the gap between the furnace front area, the furnace back area and the small temperature area. Its temperature is related to the temperature of the adjacent temperature area. The temperature near the boundary of each temperature area may also be affected by the temperature of the adjacent temperature area. In addition, the workshop temperature is maintained at 25°C.

In actual production, the set temperature of each temperature zone and the speed of the conveyor belt can be adjusted to control the quality of products. On the basis of the above experimental setting temperature, the setting temperature of each small temperature zone can be adjusted within the range of ±10°C. During the adjustment, the temperature in small temperature zone 1~5 should be consistent, that in small temperature zone 8~9 should be consistent, and that in small temperature zone 10~11 should be kept at 25°C. The speed of the conveyor belt is adjusted within the range of 65~100 cm/min.

2. Research and analysis

(1) Based on density

Method description: Considering the fact that different density regions may exist in the data set, from the density-based perspective, outliers are objects in the low-density region. The outlier score of an object is the inverse of the density around the object.

Method evaluation: the quantitative measure that the object is an outlier is given, and it can be handled well even if the data has different regions; Large data sets are not applicable; Parameter selection is difficult.

(2) Based on clustering

Method description: a method to detect outliers by clustering is to discard small clusters far away from other clusters; The other is a systematic approach, first clustering all objects, and then evaluating the extent to which the objects belong to the cluster (outlier score)

Method evaluation: Clustering techniques to find outliers may be highly effective; The quality of clusters produced by the clustering algorithm has a great influence on the quality of outliers produced by the algorithm. From these temperature changes, it can be seen that the data should be analyzed in stages.

On the basis of the original optimization with some restrictions, according to the different constraints of the solution, the final conclusion can be reached.

3. Model building

In the furnace temperature curve, the area with temperature greater than 217 is the smallest. Here, the objective function can be obtained by integral method, and then the constraint conditions can be obtained according to the process boundary. Finally, the intelligent algorithm is used to solve the problem.

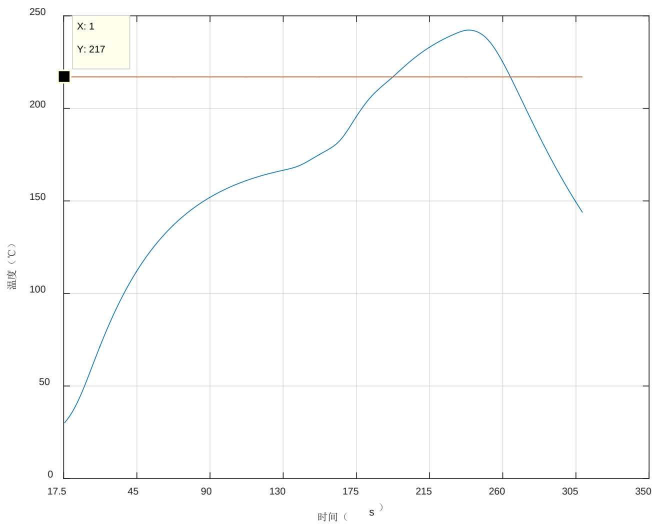

Figure. 1 Time-temperature diagram

In order to meet the requirement of symmetry on both sides of the area section whose furnace temperature curve is greater than 217, it is necessary to take the derivative of the function formula obtained, and take the equality of the absolute value of the reciprocal as one of the limiting conditions.

3.1 Introduction to wavelet analysis

Wavelet analysis (WAVELET) is a new discipline developed on the basis of applied mathematics. It has developed rapidly in recent decades. As a new time-frequency analysis tool, wavelet analysis has become a very active research field in the world. From the point of view of pure mathematics, wavelet analysis is the crystallization of half a century of work in the field of harmonic analysis. From the point of view of applied science and technical science.

3.2 Establishment of wavelet transform model

Functional analysis is an important branch of mathematics that began to develop at the beginning of last century. It is a basic component of present analysis based on set theory.

1.1 Distance Space

Let X be a non-empty set. If any two elements in X, X and y, correspond to a real number p(X,y), which satisfies:

(1) Non-negative: P (x,y)>=0, if and only if x=y, P (x,y)=0.

(2) Symmetry: P (x,y)= P (y,x).

(3) Trig Inequality: for any X in X,y,z, p(X,z)<=p(X,y)+p(y,z)

The calculation of space distance is based on the above theory, and then combined with the data given by the question, which is also the mapping relationship between time and speed. Finally, it can be concluded that the acceleration of cars in some areas is too high.

1.2 Linear Space

Let X be a non-empty set. If the linear operation -- addition of elements and scalar multiplication of elements are specified in X, and the associative and distributive laws of addition or scalar multiplication are satisfied, then X is called a linear space or vector space. For any vector in linear space we define its length in terms of the norm.

By analyzing the distance in space, multiplying it by a non-empty vector, we can finally get a calculation based on linear space.

1.3 square integrable space

L2(μ(X)) represents the set of all square-integrable complex-valued measurable functions on X in an almost everywhere sense. Square integrability means that the integral of the square of the absolute value of the function is finite.

1.4 Banach space

Banach Space is a complete Normed Vector Space, which is an extension of Hilbert Space. A Banach space is defined as a complete linear normed vector space. That said, it is a real number or the plural vector space and has a perfect norm | | "| |, namely its every Cauchy Cauchy series is convergent.

In the same way, the calculation of Banach space is based on the linear space by adding a norm to the data, so that each segment of the car can have a convergence, but this will also bring the speed value may exceed the maximum value allowed (Figure 7).

2. Important wavelet theory;

2.1 The proposal of wavelet transform

Multiply the same function, and then take the Fourier transform:

This windowing transform allows us to analyze the frequency characteristics of a signal in any local range, which is superior to the Fourier transform. The Fourier Transform of this kind of windowed Transform is collectively called the Short Time Fourier Transform (STFT). But the time-frequency window does not change with the change of frequency and time, so its flexibility and universality are limited.

The construction and selection of wavelet bases are the main content of wavelet analysis. When using basic wavelets, such as binary wavelets, binary dual wavelets, frames, and wavelets, there are many important points that must be considered for time-frequency analysis and other applications. They are: the size of the time-frequency window, the complexity and effectiveness of the calculation, the simplicity of the implementation, the smoothness and symmetry of the fundamental wavelet, and the approximation order.

For the third problem, the wavelet transform is adopted. Firstly, according to the established equation of furnace temperature curve, the objective function is established through integration, and then the constraint conditions are established according to the process boundary. Finally, the wavelet transform algorithm was used to solve the problem. Finally, when the optimal furnace temperature curve was reached, 185°C (small temperature range 1~5), 208°C (small temperature range 6), 240°C (small temperature range 7) and 252 °C (small temperature range 8~9), the corresponding area was 968.24cm2.

4. The model results

For problem 4, the wavelet transform algorithm and quadratic derivation of function are also adopted. First, the second derivative of the furnace temperature curve function is carried out, so that the second derivative function is obtained through the origin of coordinates. Then combined with the three constraints and objective functions established by the problem, it can be concluded that when the optimal furnace temperature curve reaches 183°C (small temperature range 1~5), 205°C (small temperature range 6), 241°C (small temperature range 7) and 253°C (small temperature range 8~9), the corresponding area is 1096.38cm2.

References

[1] Zhang Liangjun, Chen Junde, Liu Mingjun, Chen Rong. A Case Study of Data Mining [M]. Beijing: China Machine Press, 2016/1:1955-200.

[2] Lei Yu, Feng Shi, Hui Wang, Fei Hu. Analysis of 30 Cases of MATLAB Intelligent Algorithm [M]. Beijing: Beihang University Press, 2015: 27.

[3] Yu Shengwei. Matlab Mathematical Modeling Classical Case Practice [M]. Beijing: Tsinghua University Press, 2015:201-209.

[4] Yu Shengwei. Case Analysis and Application of MATLAB Optimization Algorithm [M]. Beijing: Tsinghua University Press, 2015: 351-359.