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Prediction Model of Rolling Force based on KNN

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Abstract

It is of great practical significance and scientific value to use machine learning method to predict rolling force so as to better serve the actual production, In view of the fact that the rolling force data is nonlinear and difficult to be accurately predicted by linear regression method, this paper proposes a rolling force prediction model based on KNN regression algorithm, which uses the KNN regression algorithm after training to predict the rolling force data, and compares it with the linear regression algorithm. The experimental results show that the KNN regression algorithm is much better than the linear regression algorithm in terms of training time and training accuracy..

Keywords

Prediction Model, Machine Learning, KNN Algorithm.

1. Introduction

With the continuous application of machine learning technology in materials, using traditional test methods to develop the production process of copper alloy products obviously can not meet the requirements of modern development. It not only takes a long time, but also wastes resources, and can not meet the requirements of energy conservation and environmental protection in the new century [1]. Therefore, by using machine learning technology to predict the process model in the process of copper alloy manufacturing, the corresponding process can be formulated or optimized, which can not only improve the production quality of copper alloy products in China, but also speed up the development of high-precision and large-scale copper alloy in China. In recent years, artificial intelligence has made new progress and breakthroughs, and machine learning has played a very important role. At present, researchers in various fields of the whole society are using machine learning to solve difficult problems, making machine learning become a hot treatment means [2].

2. KNN Algorithm

Neighbor algorithm, or k-nearest neighbor, is one of the methods in data mining[3]. The so-called k nearest neighbors means k nearest neighbors, which means that each sample can be represented by its closest k nearest neighbors. The nearest neighbor algorithm is a method to classify every record in the data set.

2.1 Principle of k-nearest neighbor algorithm

The simplest and primary classifier is to record the corresponding categories of all the training data. When the attributes of the test object and the attributes of a certain training object match completely, they can be classified[4]. But how can all the test objects find the training objects that exactly match them. Secondly, there is a problem that a test object matches multiple training objects at the same time, resulting in a training object being divided into multiple classes. Based on these problems, KNN is generated. uestion.

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2.2 k-nearest neighbor regression algorithm

The value of the point to be predicted can be obtained by calculating the average value of the nearest k points. The "nearest distance" here can be Euclidean distance or other distances. The specific effect depends on the data. The same idea. As shown in the following figure, the x-axis is a feature, y is the value obtained by the feature, and the red point is a known point. To predict the position of the first point, calculate the average value of the three closest points (three red points in the Yellow wireframe, get the first Green Point, and so on, and then get the green line. It can be seen that the predicted value is obviously more accurate than the straight line.

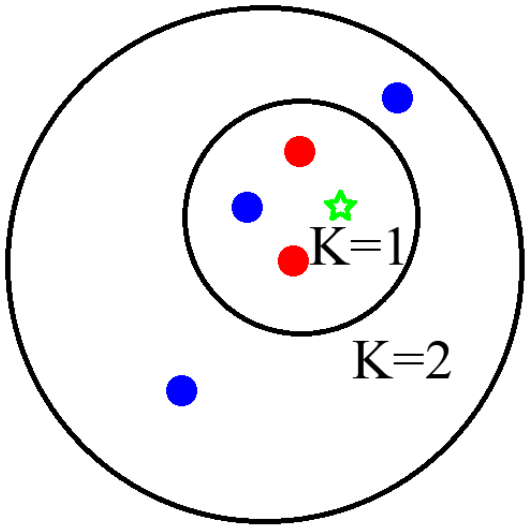

Figure 1. k-nearest neighbor regression algorithm

2.3 The main advantages of KNN

The main advantages of KNN are:

(1) The theory is mature and the thought is simple. It can be used for classification and regression.

(2) It can be used in nonlinear classification.

(3) Because KNN method mainly depends on the limited adjacent samples around, rather than on the method of identifying the class domain to determine the category, KNN method is more suitable than other methods for the sample set to be classified with more overlapping or overlapping class domain.

(4) Compared with naive Bayes and other algorithms, it has no hypothesis for data, high accuracy and insensitive to outliers[5].

(5) The complexity of training time is lower than algorithms such as support vector machine.

(6) This algorithm is more suitable for the automatic classification of the class domains with large sample size, while the class domains with small sample size are prone to misclassification.

3. Rolling force based on KNN

3.1 Rolling force model

Based on the core task of the research on the rolling force process model based on machine learning, the rolling process model of the important process parameters in the rolling process of the rolling force is constructed, so that it can predict and analyze, optimize the rolling process in the rolling process, and then guide the process adjustment in the actual production process, from the pursuit of large-scale, high speed, continuity to energy saving, and improve High product quality. Energy consumption and final product quality are largely determined by the setting of operation parameters

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in the production process. Optimal parameter settings help to improve product quality, such as accuracy of strip shape and thickness, and make full use of equipment capabilities.

3.2 Construction process of rolling force model

The construction process of rolling force model is as follows:

Step(1): Collect the rolling force data.

Step(2): Put the data into database storage after integration, and ensure that there is no missing or abnormal data.

Step(3): Initialize KNN machine learning algorithm

Step(4): The features related to rolling force are added to the input set, and the corresponding rolling force is added to the label set. Test KNN algorithm with input machine and label set as input and output of KNN algorithm

Step(5): When the number of iterations n is reached, the operation of the algorithm is stopped.

Step(6): After the number of iterations, the remaining test sets are divided into test sets and label sets, which are input into KNN algorithm. Verify the performance of the algorithm.

The figure of construction process of rolling force model is as shown in Figure 2.

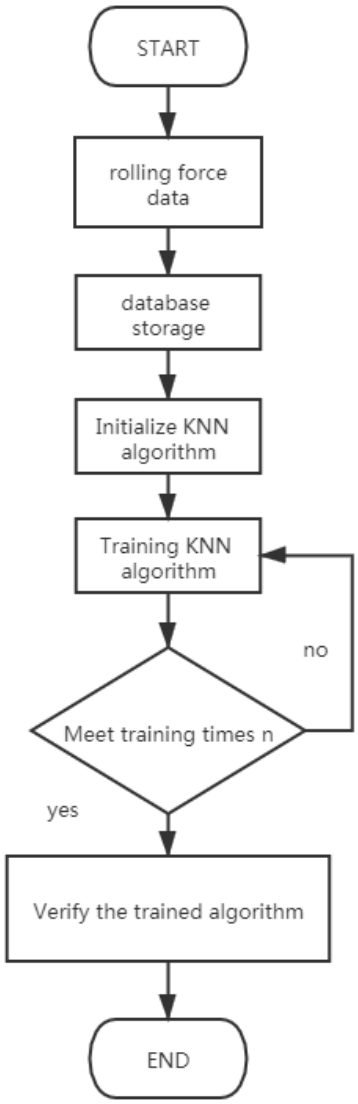

Figure 2. flow chart of rolling force model

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4. Experimental Results and Analysis

4.1 Experimental Environment

The experimental environment of this article is in the Windows 7, the CPU is Intel (r) Core (TM) i5-6500@3.20GHz, the RAM is 8.00G, the numpy model is used to build a k-nearest neighbor prediction model, and the Python version is 3.6.

4.2 Data preprocessing

The sample data of the rolling force is subjected to Min-Max normalization through formula (1), so that the sample data is between [0, 1].

$$X_{norm} = \frac{X - X_{\min}}{X_{\max} - X_{\min}} \tag{2}$$

Among them: X_{max} and X_{min} represent the maximum and minimum values in the number of samples. The experiment uses root mean square error (RMSE) and as the evaluation criteria of the model, namely:

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(y_i - y_i')^2} \tag{2}$$

4.3 Result Analysis

In order to make the k-nearest neighbor regression algorithm have better contrast, this article uses linear regression as the comparison model. The training samples are input into the training model for learning, and the prediction results are output after the model training is completed. The prediction comparison results of each model are shown in Figure 3.

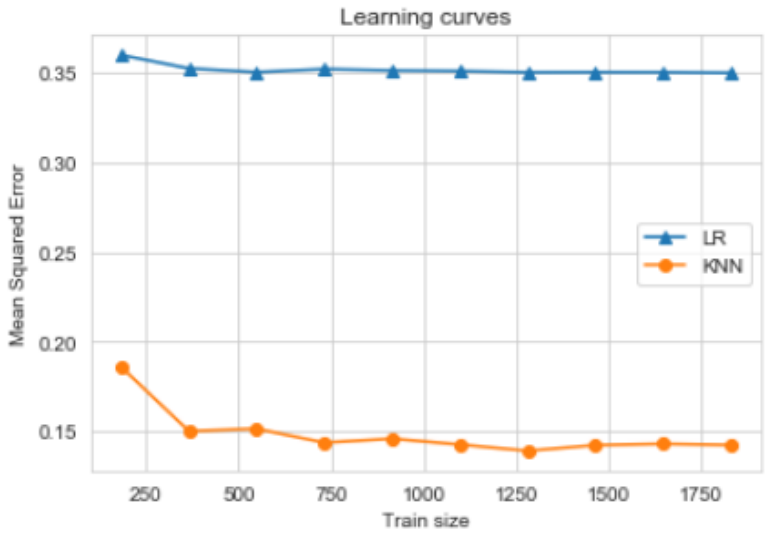

Figure 3. Changes in the training function of each model

The calculated error values of each model are shown in Table 1:

It can be seen from the table that comparing the prediction MRSE of the k-nearest neighbor regression model and the linear regression model, it is found that the evaluation index value of the k-nearest neighbor regression model is less than that of the linear regression model. Effectively improve prediction performance.

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Table 1. Learning curves of each model

Model nam	RMSE
k-nearest neighbor regression	0.35
linear regression	0.14

5. Conclusion

Aiming at the problem that the rolling force is difficult to determine in the model, a k-nearest neighbor regression based rolling force prediction model is designed and implemented. k-nearest neighbor regression algorithm is used to predict the rolling force. The simulation results show that k-nearest neighbor regression rolling force prediction model has better prediction accuracy and smaller prediction error than linear regression prediction model.

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