Fast Adaptive Machine Vision Localization Algorithm Based on Support Vector Regression Prediction

He Huang[1], Honghu Ge[2]

[1]Shenzhen Camer King Technology Co.,LTD, Shenzhen, China

[2]Jiangsu Jinxin Photoelectricity Technology Co.,LTD, Nantong, China

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Abstract: In this paper, a fast adaptive machine vision positioning algorithm based on support vector regression prediction is proposed to solve the problems of low efficiency and slow calculation speed of traditional machine vision positioning algorithms. Firstly, the algorithm uses relative threshold binarization to the template and the sampled image, which not only effectively overcomes the influence of illumination, but also reduces the amount of data. Then, it uses the Golden Tower of the two-layer image to reduce the calculation amount of the algorithm. In the matching search, it uses the method of adaptive step length to further speed up the matching, and can set the termination conditions to further speed up the speed. The algorithm quickly locates near the target by rough matching, and then locates at the center of the target by fine matching, which greatly improves the matching speed and ensures the accuracy of the algorithm. The algorithm is fast and accurate, and can meet the real-time requirements. In this paper, the method of applying support vector machine (SVM) to air traffic flow forecast is studied, an autoregressive forecast model based on SV M is established, and some key problems such as the determination of model parameters are discussed. On the whole, the prediction accuracy and stability of the combined prediction model are better than SVM prediction model. Support vector machine can solve the traditional difficulties encountered in the research of machine learning, such as over-learning and under-learning, local minima and small samples.In many applications of machine vision, especially in the field of semiconductor industry manufacturing, it is often necessary to perform efficient target recognition and matching for specific objects, which requires the image matching algorithm to have high robustness, and also requires less matching time and Higher matching accuracy. By providing the system with prototypes of such objects to be measured, it is very useful to find all types of objects in other images. Template matching is one such method. As an effective pattern recognition technique, it can more directly reflect the similarity between images by using image information and prior knowledge about the recognized pattern.

1. Introduction

Support Vector Machine (SVM) is a machine learning method in recent years. It is an algorithm based on statistical learning theory, and it shows excellent performance in solving classification and regression problems [1]. In this paper, SVM is applied to air traffic flow forecasting. Aiming at the shortcomings of single SVM forecasting method, a combined forecasting method is proposed by combining SVM with traditional forecasting methods, and a comparative experiment is carried out by using actual traffic data. The results show that the combined forecasting method is superior to both traditional autoregressive forecasting method and single SVM forecasting method [2] on the whole. Based on the in-depth analysis of the vector regression prediction, this paper proposes a real-time machine vision positioning algorithm, and applies it to machine vision recognition, and achieves good results. The unnecessary calculation is reduced, the matching efficiency is greatly improved, and the influence of brightness change caused by illumination change is overcome. Support vector regression is a regression algorithm based on SVM, which has been successfully applied in practical engineering. The basic idea of the algorithm is to increase the dimension of data, and the construction of decision function is realized in high-dimensional space, so as to achieve the purpose of linear regression. In this process, how to choose regression parameters will determine whether its theoretical advantages can be realized.In many applications of machine vision, especially in the field of semiconductor industry manufacturing, it is often necessary to perform efficient target recognition and matching for specific objects, which requires the image matching algorithm to have high robustness, and also requires less matching time and Higher matching accuracy. By providing the system with prototypes of such objects to be measured, it is very useful to find all types of objects in other images. Template matching is one such method. As an effective pattern recognition technique, it can more directly reflect the similarity between images by using image information and prior knowledge about the recognized pattern.

2. Support vector regression prediction

2.1. Support vector regression prediction model

According to the limited sample information, Svm seeks the best compromise between the complexity of the model, that is, the learning accuracy of a specific training sample, and the learning ability, that is, the ability to identify any sample without errors, in order to obtain the best generalization ability [3]. It shows many unique advantages in solving nonlinearity and small samples. The algorithm has the characteristics of self-learning and self-adjusting model, and can produce good prediction results for various complex nonlinear systems. Applying it to function fitting regression prediction is called support vector regression. At present, it has become an important means for researchers to solve nonlinear time series prediction, and has been successfully applied in many prediction fields [4]. However, like other learning algorithms, its prediction effect depends on the choice of its free parameters. Therefore, it is a key problem to choose appropriate free parameters according to the actual data model.

Support vector machine is the most practical content in statistical learning theory [5]. It is transformed from a special type of hyperplane in the case of linear separability, the so-called optimal classification hyperplane, and then the problem is transformed into a convex quadratic programming problem. Different from linear regression, nonlinear regression is to map the training samples to high-dimensional space through nonlinear transformation, and realize linear transformation in high-dimensional space through kernel function, when the given data training set is linearly inseparable.In many applications of machine vision, especially in the field of semiconductor industry manufacturing, it is often necessary to perform efficient target recognition and matching for specific objects, which requires the image matching algorithm to have high robustness, and also requires less matching time and Higher matching accuracy. By providing the system with prototypes of such objects to be measured, it is very useful to find all types of objects in other images. Template matching is one such method. As an effective pattern recognition technique, it can more directly reflect the similarity between images by using image information and prior knowledge about the recognized pattern.

2.2. Prediction results of SVM autoregressive model

SVR method has a perfect theoretical foundation and good learning performance, and has achieved fruitful results in the field of nonlinear time prediction, which is a promising research direction. However, it still faces new challenges in specific application, and the following key problems still need to be solved. First, the selection of kernel function. The performance of is largely dependent on the choice of kernel function. Some experiments show that kernel functions have almost the same effect in classification, but they are different in regression. Different kernel functions have great influence on the fitting results. At present, most literatures use radial basis function as kernel function, and good fitting results have been achieved. Other methods that can be used in kernel function will be further studied. Table 1 yuan shows the traffic data of 7 yuan week predicted by SVM autoregressive prediction model and traditional polynomial autoregressive and robust autoregressive prediction model. Fig. 1 yuan shows the fitting and prediction results of SV M model with Wednesday's data as an example. Experiments show that SVM model has higher prediction accuracy and better stability than polynomial and robust models.

Table 1 Prediction error of the first 7 yuan week flow of various prediction models

Time	Polynomial model	Robust model	SVM model	Composite pattern
Sunday	6.49%	10.23%	0.71%	-0.64%
Monday	-2.12%	-1.3%	-0.35%	-0.5%
Tuesday	11.43%	1.42%	1.22%	0.27%
Wednesday	50.02%	3.56%	-4.12%	-0.62%
Thursday	2.62%	0.78%	0.53%	-1.06%
Friday	17.42%	7.37%	-1.41%	-0.07%
Saturday	3.42%	4.13%	0.01%	-0.36%

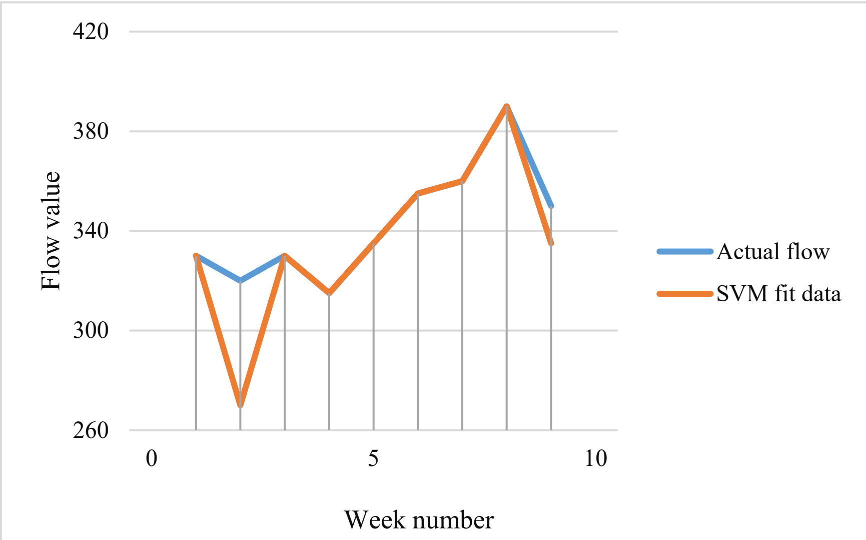

Figure 1 Output Value and Actual Flow of SVM Model in

3. Fast Adaptive Machine Vision Localization Algorithm

Data-based machine learning is an important aspect of modern intelligent technology. The research starts from the observed data samples to find rules, and uses these rules to predict future data or unobservable data [6]. Including pattern recognition, neural network, etc., one of the common important theoretical bases of existing machine learning methods is statistics. The ability of machine learning to correctly predict the data to be output through known data is the generalization of machine learning [7]. Experience shows that the best prediction result does not necessarily come from the smallest training error, which is the phenomenon of over-learning. This problem will occur when the samples are insufficient or the design of machine learning is unreasonable, and the two are interrelated. Therefore, under the premise of insufficient samples, using complex machine learning can not necessarily improve its popularization ability, and there is an irreconcilable contradiction between them.

3.1. Overview and process of algorithm

Firstly, we analyze the histogram of the original image, get the threshold at the peak, then calculate the relative threshold according to the formula, and then binarize the template according to the formula. Then, we use the same method to binarize the sampled images, and then use the method of interlaced and column-separated selection to form the two-story pyramid. Similarly, we also binarize and pyramid the sampled images. When matching, we use SAD value as the similarity criterion. The matching position of the minimum output SAD value is determined by the initial threshold E0. Once the initial threshold is exceeded, this matching is terminated regardless of whether this matching is finished, where width and height are the width and height of the template. During the matching search, the adaptive step template matching method is used in each search subgraph. If the SAD value is large, it will take a larger step length and quickly skip the unreasonable position. Generally, when the SAD' value is greater than E0, the step length will be one fifth, when the SAD value is less than E0 and greater than half of E0, the step length will be reduced to one tenth, and when the SAD' value is less than half of E0, the step length will become 1 yuan. After the rough matching result is obtained, the step length will be reduced to one tenth. Experiments show that this algorithm can effectively alleviate the above contradictions, that is, on the premise of ensuring the accuracy of template matching, it also greatly improves the efficiency of template matching [8]. The algorithm flow is shown in figure Escape Room: Tournament of Champions:

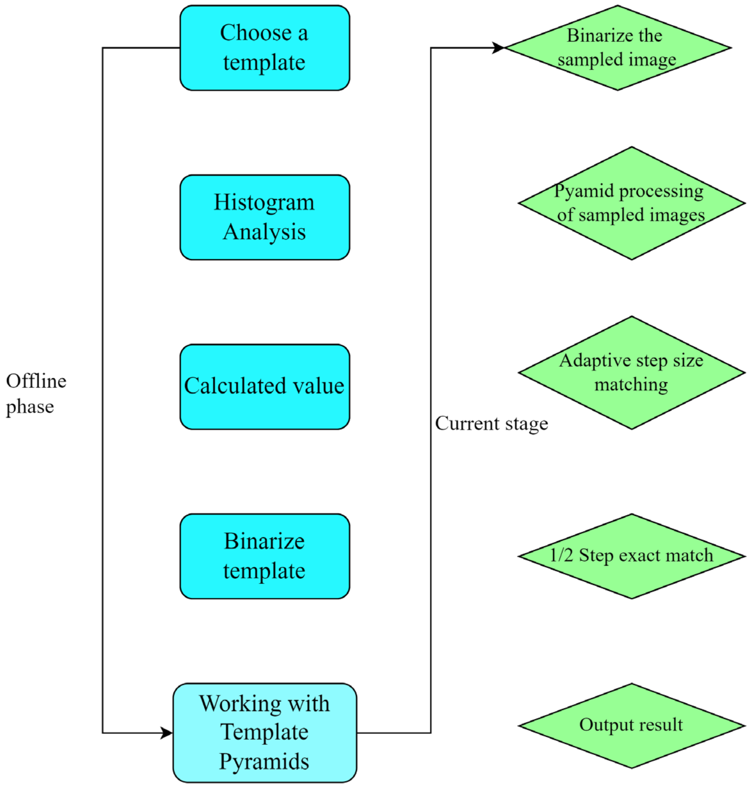

Figure 2 Escape Room: Tournament of Champions algorithm flow chart

3.2. Experimental results and analysis

We put the data of intelligent vision positioning algorithm and the data of laser interferometer together to clearly see the specific detection errors of our vision algorithm.The key parameters of the algorithm are determined by mathematical calculation and template selection experiment. Then, the detection accuracy of vision algorithm is tested on the built experimental platform and compared with other representative vision algorithms. Through the experimental results, it can be seen that our intelligent adjustable positioning algorithm has the highest accuracy, and its running time is the fastest and highest among all comparison algorithms [9]. Finally, in order to make the algorithm have practical application value, we carried out a robustness experiment. Through the experiment, we found that the algorithm still has good anti-interference ability under different illumination conditions, salt and pepper noise and Gaussian noise with maximum variance. Our visual intelligent positioning algorithm has the smallest detection and positioning error and the least average time consumption among all the comparison algorithms, and is the best in comprehensive performance[10].The results show that the combined forecasting model has better forecasting stability and tracking ability than SVM model, and its overall performance is better than SVM model. However, the combination forecasting method is a compromise method in essence, which will generally reduce the forecasting performance. In the future research, we will only consider special treatment for abnormal data and adopt the combination model, while other data will still adopt the SVM model, which is expected to improve the performance and expand the application field.Therefore, it can be proved that the proposed intelligent vision positioning algorithm can effectively improve the running speed and detection accuracy of the algorithm, and is more suitable for fast and high-precision vision positioning in the repair process of new high-density LED chips. And we put the data of intelligent vision positioning algorithm and the data of laser interferometer together to clearly see the specific detection error of our vision algorithm.

4. Conclusion

The experimental results and analysis show that the machine vision algorithm based on relative value proposed in this paper can effectively eliminate the interference of brightness change. Compared with other template matching methods, by combining the relative threshold binarization of data with the search strategy of adaptive step length, it greatly reduces the calculation amount of template matching and greatly improves the speed of matching algorithm on the premise of ensuring high robustness of image matching. The positioning of the target is accurate and has good adaptability, thus laying a foundation for the subsequent target positioning. Experiments show that this method is very effective in applications that need real-time recognition. In order to achieve better results, this algorithm needs to continue to study the situation of large occlusion, nonlinear illumination and rotation of the matching target. In this paper, the method of adaptive machine vision positioning using SVM is studied, and an autoregressive prediction model based on SVM is established. Then, aiming at the deficiency of SVM model, a combined forecasting model is put forward on the basis of synthesizing SVM and other forecasting methods, and the weight coefficient and compensation coefficient of the combined forecasting model are determined by multiple linear regression method. Numerical experiments are carried out with measured data.

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