Application and Development of Neural Network Technology in Mechanical Automatic Processing Parameters

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Abstract. With the improvement of intelligent and automation in the mechanical field, high quality products can be produced at the same time of mass production. But in the process of machining, the machining size and shape error of the tool will cause the change of cutting force, and produce a large error and error reflection. How to eliminate error reflection has become an urgent problem in the field of computer. In this paper, neural network is introduced to solve this problem, and a neural network model is proposed. The results show that the automatic method is 35S faster than the traditional manual method, 55s faster than the traditional manual method, and the automatic method is 20 seconds faster than the traditional manual method.

Keywords: Neural Network Technology, Mechanical Automation, Processing Parameters

1. Introduction
With the continuous progress of big data technology, neural network technology has become an indispensable technology in our life. Artificial neural network (ANN), especially self-organizing map (SOM) based on unsupervised learning, is a good method for pattern clustering and recognition.

With the development of computer technology, many experts have studied the mechanical automation technology. For example, some domestic teams have studied the architecture of service-oriented mechanical automation processing system, used wavelet packet decomposition (WPD) to decompose the cutting torque components in the original signal, extracted the wavelet coefficients of different wear states, and monitored and identified the feature vectors of cutting torque signals by using k-means clustering and radial basis function neural network (RBFNN). Experiments on different multivariate characteristics show that the monitoring and recognition are effective. The average velocity component and its statistical characteristics are measured by the dual component laser Doppler velocimeter [1]. The neural networks such as generalized feedforward, radial basis function and cooperative neural fuzzy inference system are tested. The results are compared with experimental data and used to reconstruct the average velocity and turbulence intensity distribution in axial and tangential directions. For the section considered, the best prediction with the highest correlation coefficient is obtained by using generalized feedforward network. The prediction accuracy of the network can be improved by optimizing GNN initialization parameters by QGA. The mechanical fault diagnosis model can solve the problem of NC machine tool fault diagnosis under the condition of
small sample. Some experts have studied the simulation of WEDM based on genetic neural network, and established the mathematical model of the process of abrasive water jet cutting stainless steel. The nonlinear relationship between cutting process parameters and cutting surface quality is established. By adjusting the cutting speed of water jet, the surface quality of parts can be indirectly controlled. Through the test of data set, the trained ANN model is used to get satisfactory results. A method based on deep learning and support vector regression is proposed. Convolutional neural network is used to improve the ability of feature extraction, while convolutional neural network is rarely used for one-dimensional signal. In addition, support vector regression (SVR) is an improvement of SVM, which has strong generalization ability and can be used to improve classification methods. The method is implemented by a hybrid model, which combines the two technologies. The method is applied to the classification of bearing failure modes, and the classification effect is better than regression. The design of a neural network estimator for the size of molten pool used for online quality monitoring is introduced. A neural network estimator is designed to estimate the size of the molten pool according to the surface temperature of different points on the weld surface. In order to evaluate the performance of neural network estimator, a series of overlay tests are carried out. The experimental results show that the proposed neural network estimator can estimate the size of the pool very well. In addition, some experts have also studied the automatic measurement of cellular mechanical properties. The feature extraction strategy based on ICA and RMI is used to extract the characteristics of different mechanical modes (including normal mode and gear pitting mode), and then the classic neural network (MLP, RBF or SOM) is trained to achieve the final classification [2]. By ICA, the embedded higher-order characteristics in multi-channel vibration measurement can be obtained effectively, which ensures the correct recognition of mechanical failure mode. The experimental results show that the compound ICA SOM classifier is simple in construction and has high classification accuracy, and has great potential in machine health monitoring. A neural network method for the identification of axis trajectory of rotating machinery based on radial basis function (RBF) and wavelet moment invariants is proposed. The principle and application of the method are introduced in detail. The simulation results of three typical axis tracks are given. An adaptive neural network based trajectory tracking method for free floating space robot with actuator saturation is proposed. The neural network with global approximation is used to design online real-time adaptive learning law, which approximates the uncertain model and the saturation nonlinearity of the actuator. The robust controller can eliminate the approximation error and external interference of neural network. Control policies do not need to be model dependent and can be used when the actuator is saturated. Based on Lyapunov theory, the control strategy can guarantee the stability of the system and the asymptotic convergence of tracking error. A new method of classification of ship plate by neural network in ship preliminary design is proposed. The classification program of Ship Plate Based on neural network is developed and verified by experiments. The input variable is considered as the Gaussian curvature distribution on the plate. In the ship plate classification automation, two different input variables are used. The external characteristics of highly nonlinear VRB system are simulated by self-learning method. Although the research results of mechanical automation technology are quite abundant, there are still some shortcomings in the application of neural network technology in the application of mechanical automation process parameters [3].

In order to study the application of neural network technology in the parameters of automatic machining, the main processing parameters are found out through the research of neural network technology and mechanical automatic processing. The results show that neural network technology is beneficial to the development of machining automation.

2. Method

2.1 Neural Network Technology

(1) The concept of neural network technology
Through repeated learning of a large number of samples, the internal adaptive process constantly modifies the weights of interconnected neurons [4]. Finally, the weight distribution of neural network converges to a stable interval [5]. The interconnection structure of neural network and the stable distribution of connection weights represent the knowledge acquired through learning [6]. The artificial neural network can be used to solve related problems. For a specific input mode, the neural network can get the output mode through forward calculation, so as to get the specific solution of the input mode [7].

(2) The structure of neural network
Neural network is a physical system based on some structural characteristics of human neural network system, which is realized by electronic or optical elements [8]. This kind of system imitates the natural intelligence system from the micro level [9]. Its basic idea is to simulate the neural system of human brain from the perspective of bionics, so that the machine as an information processing system has the same ability of perception, learning and reasoning as human beings. Structurally speaking, artificial neural network is a nonlinear dynamic unit neurons [10]. Each neuron is connected with other neurons through the corresponding weighted directional communication link [11]. The fundamental purpose of studying Ann {1} is to explore the mechanism of human brain information processing, storage and search, so as to open up a new way to solve some extremely complex problems in the objective world.

(3) Application of neural network in NC machining
When the data is input to the input layer of the network, the data is transmitted to the output layer through the network structure layer and output. The result of inter layer data operation is determined by connection weight. When the connection weight changes, the corresponding output data will also change. The purpose of neural network control is to obtain the desired output by continuously adjusting the connection weights. Through learning, the neural network model can realize the mapping relationship between the input and output of the given system, and can also give the appropriate output for the input that is not in the sample set.

2.2 Automatic Machining
(1) Machining
As the main body of energy consumption in machining and manufacturing system, machine tool has the characteristics of large dynamic change and many energy sources. Cutting speed (or spindle speed), feed speed, cutting depth and other parameters. The traditional processing parameters and process route are optimized separately, and the interaction between these two links on energy consumption is ignored. On the one hand, the selection of machine tools and tools in the process route plan directly affects the selection of cutting parameters in each process; on the other hand, the selection of cutting parameters of each process also affects the energy consumption of the process route.

(2) Machining manufacturing system
Most of the existing researches on energy saving optimization of manufacturing system are based on single link, such as cutting parameter optimization, process route optimization, workshop scheduling optimization, etc., and there are many problems such as low cooperation degree and less information interaction between process planning and workshop scheduling. The energy consumption of the machining system can be further reduced by the optimization of cutting parameters, process route and workshop scheduling.

2.3 Main Processing Indexes
Processing speed refers to the sum of the area cut by the center line of the electrode wire on the workpiece in unit time under certain processing conditions, and the unit is rain2gmin. It generally refers to the average processing speed of continuously processing a workpiece. It is shown in formula (1):
\[ V = \frac{S}{t} \]  

(1)

According to the different shape of AFM probe, Hertz model has different expressions. When the probe is conical, the Hertz model equation is (2):

\[ F_{cone} = \frac{2E\delta^2 \tan \theta}{\pi(1-v^2)} \]  

(2)

For the connection weight WJK output from the jth neuron in the hidden layer to the kth neuron in the output layer, according to the gradient descent principle, the weight correction is proportional to the derivative of the square error to the weight, so the correction of WJK is shown in equation (3):

\[ \nabla^2 f(x,y) = \frac{\partial^2 f(x,y)}{\partial x^2} + \frac{\partial^2 f(x,y)}{\partial y^2} \]  

(3)

Due to the complex relationship between the influencing factors, it is difficult to determine the mathematical relationship between the surface removal amount and the process parameters. In order to analyze and control the polishing process, if the polishing process is assumed and the unquantifiable parameters are determined, the polishing process can be described as a linear process. It is shown in equation (4):

\[ \frac{dH}{dt} = K_p pv \]  

(4)

3. Experience

3.1 Extraction of Experimental Objects

According to the machining requirements, a flexible executable NC program is written with the help of Visual C++, visual basic and other programming software. The software is universal, easy to operate and modify. In addition, this open CNC system can make full use of the rich resources of PC, and effectively improve the openness of the system and the high-speed computing ability of complex data. According to the connection mode between motion controller and PC, open control system can be divided into three types: centralized multi axis controller, distributed single axis controller and bus card multi axis controller.

3.2 Experimental Analysis

The test management software of the system is TestDirector. The test is carried out in stages. Spiral test model is used between different stages. The system can only carry out the next stage test after the low-stage test is completed and the test requirements are met. The following is the test process of each stage: (1) the developer tests the module and submits the correct version of the module after the test is completed. (2) System integration. (3) The project leader submits the test application. (4) Configure the administrator to check the submitted test application, check the TestDirector, and if passed, move the source code to the controlled library. If the audit fails, return to the project group for modification. (4) After the audit is qualified, submit it to the person in charge of the test for confirmation. (6) After the test is determined, the test leader selects the test method and develops the test case. (7) The tester starts the test. (8) The phase test is over.

4. Discussion

4.1 Efficiency Verification of Automatic Measurement System
In order to verify the efficiency and accuracy of the automatic measurement system of high-speed cell mechanics, we used the traditional manual method and the automatic method proposed in this paper to measure the mechanical properties of the same kind of cells, and compared the measurement time. As shown in Table 1.

**Table 1.** Comparison of the time taken to continuously measure the mechanical properties of cells by two methods

|                        | Traditional manual method | Automation methods |
|------------------------|---------------------------|--------------------|
| Setting time (s)       | 45                        | 10                 |
| Scanning time (s)      | 60                        | 5                  |
| Measurement time (s)   | 35                        | 15                 |

From the above, it can be seen that the time required for the traditional manual method to set the needle is 45s, the time required for the traditional manual method to scan is 60s, and the time required for the automatic method to measure is 35s; the time required for the automatic method to set the needle is 10s, the time required for the automatic method to scan is 5s, and the time required for the automatic method to measure is 15s. The specific results are shown in Figure 1.

**Figure 1.** Comparison of the time taken to continuously measure the mechanical properties of cells by two methods

From the above, it can be seen that the time required by automatic method is 35s faster than that required by traditional manual method, the scanning time required by automatic method is 55s faster than that required by traditional manual method, and the measuring time required by automatic method is 20s faster than that required by traditional manual method.

### 4.2 Block Processing Means and Processing Quality Analysis

The specific processing method is to divide the processing unit into several blocks for laser processing. In the process of processing, the focal length of laser processing is adjusted by changing the distance between the processing unit and the laser head, so as to solve the problem of incomplete processing in the unit processing. In this paper, the block spacing is designed for the second time, and the parametric laser processing experiment is carried out in the fourth layer of the unit. The experimental results are processed. The data processing of block spacing and overlap distance is shown in Table 2.
Table 2. Interval size parameters between cell blocks

| Cell block type | Interval size between unit blocks (mm) |
|----------------|----------------------------------------|
|                | 1           | 2           | 3           |
| 1              | 0.213       | 0.416       | 0.537       | 0.321       |
| 2              | 0.232       | 0.234       | 0.682       | 0.452       |
| 3              | 0.623       | 0.562       | 0.432       | 0.523       |

It can be seen from the above that the interval size of the unit divided into one block is 0.213, 0.416, 0.537, 0.321; the interval size of the unit divided into two blocks is 0.232, 0.234, 0.682, 0.452; the interval size of the unit divided into three blocks is 0.623, 0.562, 0.432, 0.523, and the specific results are shown in Figure 2.

Figure 2. Interval size parameters between cell blocks

Through the analysis of the transmission and distortion of the interval size, it can be seen that with the increase of the interval size, the transmission of the unit shows a downward trend, and the distortion rate shows an upward trend. This is because the larger the gap, the less aluminum layer can be processed, thus improving the processing quality and defect rate.

5. Conclusion
An assembly sequence planning system based on binary vector representation is developed. The neural network method is used to analyze the optimal assembly sequence of the assembly system. Different construction methods of contact matrix and Boolean operator are adopted. The neural network method is used to determine the optimal assembly sequence. The input of network is the set of assembly sequence data. This paper discusses a new modeling method artificial neural network. The feasible assembly sequence and optimal assembly sequence of the assembly system are analyzed by neural network method.

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