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Localization transformation of five coordinate milling machine

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Abstract

As five coordinates gantry milling machine is not able to meet the requirements of the parts of precision and efficient processing, for the machine tool's electrical function degradation, mechanical part aging, CNC system backward, now it needs to upgrade the whole electrification and fix the mechanical part by Huangzhong, HNC - 848 c/M bus type numerical control system. Though the machine localization reformation, the precision and efficiency of the machine tool are improved, thus the application of domestic CNC system and functional components in the machine tool are promoted.

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1. Introduction

Traditional machine tools in the processing of small yield, simple shape parts, can maintain a high productivity. With the increase of the complexity of the processing parts and significantly increased production, traditional CNC machine tools has been unable to meet the change, weakness existing in the traditional machine, such as the lack of rigid, anti vibration, thermal deformation, sliding frictional resistance and transmission elements exist between the gap, it is difficult to perform CNC machine tool for the machining accuracy, surface quality, productivity and service life of requirements^[1, 2]. It is urgent to transform the traditional machine tool. Transformation of traditional machine tools to solve this contradiction. The advantage is that:

(1) Saving money, the expenses can save about 60% when the transformation of NC machine compared with the purchase of new machine.

(2) Short cycle, the transformation of the machine cycle is much shorter than the new customized equipment^[3].

(3) More stable performance, because the original machine components have been aging for a long time, it almost won't produce the deformation and stress and affect the precision.

2. The overall transformation project

NC machine is a complete product composed of precision mechanical components (e.g., ball screw, high precision guide rail, precision bearings and main shaft) and complex electrical components (such as numerical control system, drive and servo motor and precision measurement system). It is the mechanical processing of the various control information using a code of digital representation by the information carrier inputting into numerical control device. After processing the numerical control device and a variety of control signals, it can control the action of machine tool. According to the shape and size of the drawing requirements, it automatically to parts processes the parts^[4]. The composition of NC machine block diagram is shown in figure 1.

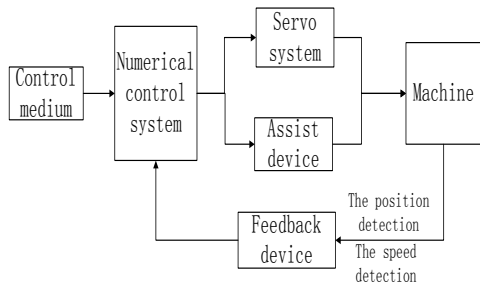


Fig. 1 CNC machine composition block diagram

In 1997, our company purchased a 5-axis NC double column milling planer machine V-2000, after into the factory it increased greatly the production efficiency. But as the machine running for a long time, the machine ran unstable. Machine electric aged serious, and system function, most of the cable ageing, mechanical machine also had some problems, even 5-axis linkage not implemented. Dropping in combined precision machine made it unable to meet the requirements of parts processing. Therefore, our company decided to implement localization of transformation of the machine, including electrical and mechanical aspects of the reform [5].

3. The machine electric transformation

3.1 The choice of CNC system

The machine ran NUM system firstly, because the running time was too long, system operation was unstable, and the system development was limited. Our company uses the new HNC-8 type numerical control system to transform. The operation of the modified interface is shown in figure 2.

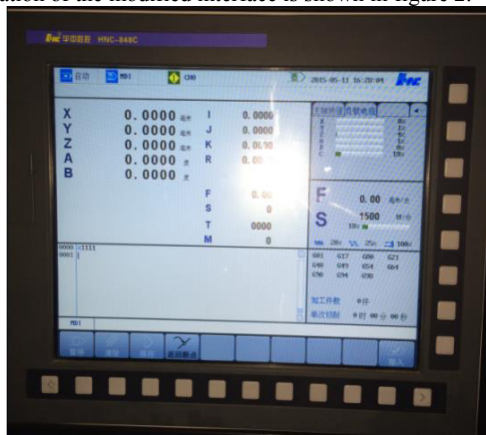


Fig. 2 the operating interface of HNC-8 type

HNC-8 series system is HNC CNC production digital bus high-end CNC equipment. It uses the integration module design, open architecture, with independent intellectual property rights based NCUC industrial field bus technology, supports the function extension and data exchange of the I/O bus type, CF card, USB, Ethernet, etc.

HNC-8 has the following advantages:

- (1) The multi-axis linkage, multi-channel control function
- (2) High speed, high precision control function
- (3) Series, good complete set
- (4) Intelligent
- (5) The cloud CNC
- (6) Customer customization development

3.2 The choice of servo unit

The transformation of servo unit is shown in figure 3.



Fig. 3 the figure of servo unit transformation

- (1) The HNC numerical control bus type PLC module, 96input points, 64output points.
- (2) To remove the original X, Y, Z, A and B axis servo drive and motor, use HNC numerical control bus ac servo drive and motor to replace the original drive and motor.
- (3) According to the analysis of the machine tool electrical design, draw a new electrical schematic diagram, write PLC program.

3.3 The choice of auxiliary device

- (1) Replace the original mobile handheld unit: including the choice of shaft, ratio, manual pulse generator, 5-axis control, magnetic fixed way, easy to manually adjust the knife.
- (2) The original spindle have shift function, keep the spindle shift function, directional encoder replace the spindle; Increase the spindle box lubricating control function, in order to meet the spindle box lubrication control requirements.

4. The transformation of machine machinery

In view of the mechanical part degeneration, 5-axis linkage does not use series of problems, such as tinkering with the mechanical parts of the machine are as follows:

4.1 Solve the spindle box of the existing mechanical failure

In theory, the most hot temperature of motorized spindle shell oil mist more than 25°C should be regarded as unusual. Machine adopts oil mist lubrication method, originally due to poor quality of early selection of bearing. High-speed bearing temperature rise is too high and the oil mist system failure of oil supply is not timely, resulting in failure of machine tool

spindle box.

In the process of transformation, we abandon the original oil mist lubrication method and adopt the way of water. This can avoid the oil mist lubrication problems, and realize green manufacturing.

4.2 Solve the Z axis (spindle box) the jitter faults of running up and down

The spindle box has up and down shaking problem, mainly due to the bearing wear. We replace the bearing in the process of transformation and solve this problem.

4.3 The choice of auxiliary device

Machine, when in the factory, has been running continuously. As the time is too long, the Y axis appears fault such as jitter. After inspection, we find the Y axis screw serious wear and tear.

In the process of transformation, we replace the screw, and solve the problem.

4.4 Restore A and B axis function

Since into the factory, the machine doesn't use 5-axis linkage function, so it cannot reach the best working state machine.

In the process of transformation, we restore A and B axis function though replacing A and B shaft drive motor [6].

5. The transformation effect of the machine

5.1 Reach the technical parameters

After transforming the technical parameters of machine can achieve as shown in table 1.

Table 1 technical parameters

Back to the largest diameter	600mm
The motor power	6KW
Rapid feed	The longitudina:4m/min The transverse:8m/min
Cutting speed	The longitudina:0.5m/min The transverse:0.25m/min
Moving parts weight	The longitudina:700N The transverse:500N
the time of speeding up	30ms
The efficiency of machine	0.8

5.2 Achieve the precision of the range

Before transforming the precision of machine can reach the range as shown in table 2.

Table 2 the precision of the machine before transforming

Linear axis	Positioning accuracy (micron)		The vector difference (micron)		Repeat accuracy (micron)	
	Nominal value	The measured	Nominal value	The measured	Nominal value	The measured
X	150	165	100	130	100	120
Y	100	110	100	120	80	110
Z	100	150	100	130	80	100

Linear axis	Positioning accuracy (micron)		The vector difference (micron)		Repeat accuracy (micron)	
	Nominal value	The measured	Nominal value	The measured	Nominal value	The measured
X	150	85	100	15	100	83
Y	100	12	100	22	80	54
Z	100	26	100	50	80	23

After transforming the precision of machine can reach the range as shown in table 3. As shown in table 3, the precision of machine tool can meet the accuracy requirements after transforming.

Table 3 the precision of the machine after transforming

Linear axis	Positioning accuracy (micron)		The vector difference (micron)		Repeat accuracy (micron)	
	Nominal value	The measured	Nominal value	The measured	Nominal value	The measured
X	150	85	100	15	100	83
Y	100	12	100	22	80	54
Z	100	26	100	50	80	23

The precision of machine adopts Renishaw Laser detection. The laser detection result of X is as show in fig.4.

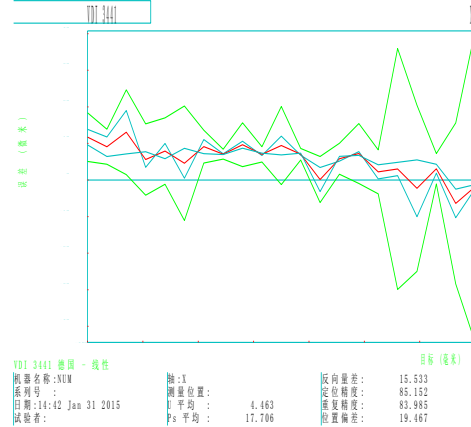


Fig. 4 the laser detection result of X

Acknowledgements

The machine transformation completed the replacement of machine numerical control system, accumulating application experience for domestic NC system in NC machine tools, improved in the electrical cabinet components, repaired the machine mechanical failure and improved the processing precision of machine tools, so the machine can meet the parts processing requirements and improve business efficiency of our company. The problems encountered in the process of transformation and solutions, can be used as the valuable experience to transform machine tool in the future.

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