A design of machine tool for switchable multi-NC systems test

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Abstract. A machine tool with 4 kinds of NC systems have been designed. The systems can control the same transmission mechanism and switch freely. The machine tool mainly used for the test of NC system function and performance. At present, the machine tool has been tested. The results show that the functions and performances of different NC systems can be compared and tested under the same condition of transmission mechanism.

1. Introduction

The aviation makes the complexity of the realm structure piece [1], requests to NC system factory to have series to turn a product in the meantime, should can provide a set a solution, such as the Siemens company according to it the 840D product become of face to the aviation realm of set solution (the SINUMERIK for Aerospace). However, because of domestic the NC system a factory want for a set a solution local aviation a manufacturing a business enterprise to use currently of the NC system to still take import as lord, even applied the NC system and also can be make in thickly process. The HNC210B NC system and the FANUC OI MC NC system of synthesize to process function of the difference doesn't clear [2], NC system reliability problem of machine tool to have become to influence the domestic application of an important factor [3]. Scholar's logarithms in all countries controls the system signal to deliver, the performance test launched a research [4~7], the function parts, NC system, the machine tool credibility [8] can make use of to the aviation to process in the business enterprise or not, need a machine to carry out various functions performance TEST.

2. Main design of machine tool

The machine tool main design is horizontal machining center, the equipment include base, guide rail, screw and rotary table etc. The NC system include Siemens, HNC, Golding, GSK Horizontal machining center design include X\ Y\ Z\ A\ B five axis, have TRAORI function, all axis used full-loop, spindle. All NC system can switchable quickly by center control box.
Machine tool includes three parts: NC system, the control cabinet, base, among them, the motor, ruler, center lubrication etc. equip to all include in the base, all signals deliver to central control cabinet, central control the cabinet be responsible for the signal separation and the NC system for switch. All spare parts choose a demand to contrast a NC system signal support, for example choose rulers with 11UASS signal type be satisfied with 4 NC systems.

3. Hardware switch design
Each NC system has own OP, control, drive, power supply etc., all power cable, signal cable connects to central control cabinet. The adoption controls switch the power cable, the signal cable adoption merges structure to carry on deliver, for promise the signal line delivers the interference problem, the NC system which is not used need power OFF.

![Figure 1. Frame of machine tool.](image1)

![Figure 2. Power cable switch.](image2)
Whole switch process to use four sets of contact sets to carry on a control, after center control switch on, have no NC system control the base. Switch SB1 controls KM 1~ KM4, When the SB1 control KM1 ON, the NC the system A connect to base, same, be SB1 to control KM2 ~ KM4 switch on, system B~system D connect to the base, use PLC to control power cable switch freely automatically.

Figure 3. Signal cable switch.

Hundreds of signal cable is more difficult than power cable. All signals include I/O, feedback use parallel connection, all signal cables connect to center control cabinet, PLC in cabinet carry on the signal allotment through an I/O point, send signals in parallel cable to base.

4. Center control design
The central control device is process the signal allotment for machine tool, choosing to carry out with Siemens PLC for carry on a choice towards cutting over signal quickly, establishing 4 signal choices to order in the procedure while M0.1-M0.4, difference to connect 4 sets control system. In centrally cut over the control procedure, establish 4 function (FC) differences to should 4 sets control system of the conversion edit and translate.

Pass to the M0.0 in the lord the OB1 in main program, chose FC:
A M0.1
CALL FC1
A M0.2
CALL FC2
A M0.3
CALL FC3
A M0.4
CALL FC4
When M0.0 activate, adjust to use FC1, make NC system1 output set to 1, then having Q0.0 been set in the power cable part at this time. Q0.1, Q0.2 and Q0.3 will be reset, the FC1 to should the program as follows:

S Q0.0 Q 0. 0 set
R Q0.1 Q 0. 1 reset
R Q0.2 Q 0. 2 reset
R Q0.3 Q 0. 3 reset

Output and input signals all programmed in center control, establish 4 function (FC) differences to should 4 sets control system of the conversion edit and translate.

Endow with IB1-IB8 in FC1 value in QB7-QB14, the IB9-IB14 endows with a value in the QB1-QB6

Endow with IB1-IB8 in FC2 value in QB15-QB22, the IB15-IB20 endows with a value in the QB1-QB6

Endow with IB1-IB8 in FC3 value in QB23-QB30, the IB21-IB26 endows with a value in the QB1-QB6

Endow with IB1-IB8 in FC4 value in QB31-QB38, the IB27-IB32 endows with a value in the QB1-QB6

The central control cabinet and the base and 4 NC systems are connected, the difference delivers signal to assign to each importation to output, carrying on a PLC logic programming, the terminal use pad which type is KTP600, completing touch to switch. The system switch the test contents for choose the system as the HNC-8, Siemens 840 DSL, GSKs 25 i etc, Hold the empress of the choice system to examine check through a touch the component importation signal "translate" whether exactitude; Switch the motor coder and scale coder, The NC system to switch on, completing a NC system is switched.

5. Test the contents and project
Testing contents for assurance can be complete to reflect NC function and performance of the system, installing a vibration, temperature, electric current sensors on the machine base, make sure the machine parts is the same towards 4 NC system to test and examination. Usually will spread the sensors install in the spindle, guide rail, bearings etc.

Test contents 1: Run machine tool each sit a mark, satisfy to sit to mark whole route of travels with suitable feed, need 5-10 times, draw up the example is shown as form:

| Test    | Range   | Speed   | Times | Time space |
|---------|---------|---------|-------|------------|
| Spindle | -       | 3000rpm | 1min  | 5s         |
| X-axis  | -800~800| 3000mm/min | 5-circle | 5s       |
| ...     | ...     | 3000mm/min | 5-circle | 5s       |
| B-axis  | -180~180| 1000mm/min | 5-circle | 8s       |

Test contents 2: Try to slice same try to slice a piece, include a S-part, NAS part etc., measure the accuracy of part, judge to compensation of function that each NC system with the same transmission mechanism.

Test contents 3: Carry on all accuracy examinations to the machine tool after switch a NC system, record the accuracy value, compensation the error use different NC systems, record the accuracy value after compensated, carry on contrast to the accuracy value, and compare the accuracy error margin for different NC systems.

The more test contents will be carry out.

6. Conclusion
Pass construction of the machine tool, it completed include Siemens system, HNC, GSK, Golding in the NC system to switch has been achieved, for record the switch test 20 times, switch from each NC system
only speed 15 min once. Machine tool each performance test, the accuracy test, part cut, function test has been done on machine tool, evaluation 4 kinds of NC system correctly.

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