

FANUC educational stand

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Abstrakt: Diplomová práce se zabývá návrhem a realizací výukového standu pro výuku řídicích systémů CNC na FS ČVUT. Stand vznikl přestavbou zařízení dříve používaného na navíjení profilů z uhlíkových vláken. K realizaci byly použity servomotory, zesilovače, řídicí jednotka CNC, přídatné karty a ovládací panely firmy FANUC. Po dokončení konstrukčních prací bylo dalším úkolem oživit servopohony a připojit je zadáním vhodných parametrů pod systém FANUC 21i MB. Pro takto vzniklý stand bylo nutné ještě vytvořit vhodný PLC program pro obsluhu potřebných funkcí a periférií a pro zajištění bezpečnosti práce se standem. Stand se v současné době používá pro výuku.

Klíčová slova: FANUC 21i MB servomotor a pohony alpha i, CNC řídicí systémy. FANUC LADDER III

1. Introduction

The work's aim was to design and build an educational stand for purposes of lecturing NC systems at Mech. Eng. faculty of CTU in Prague and as a platform for upcoming bachelor and master degree dissertations. For these purposes FANUC company presented CNC 21i MB control system with alpha drives to the university. There were 2 identical servo drives and an electric spindle of Alpha i series, 2 drives of Alpha i M6 and M2.5, CNC control system, power supply, amplifier for 2 servo drives, amplifier for one servo drive, MDI panel and also a human interface panel. For an Alpha i M2.5 drive there was another Beta series SVM1 20i amplifier bought.

2. Design and realization

With respect to the fact that the present contained a complete drive set of the whole machine, it was possible to create two work-plants. The first one is an educational stand described below and the other one is a stand for measuring precision of arc interpolation on a compound table which construction is currently finishing. That's why the main focus is on the FANUC educational stand.

In this work the final cost was also taken into account. That's why there were parts of a composite profiles reeling machine used for a construction of the main frame. The reeling machine was long unused and out of order. There was just a table with X axis and its attachment used from this device. Other parts were either made or bought.

The stand comprises of 2 main assemblies. These are a Case containing all the electronics and a Table. Parts of the table are servo drives, linear guides of axes and a table support structure

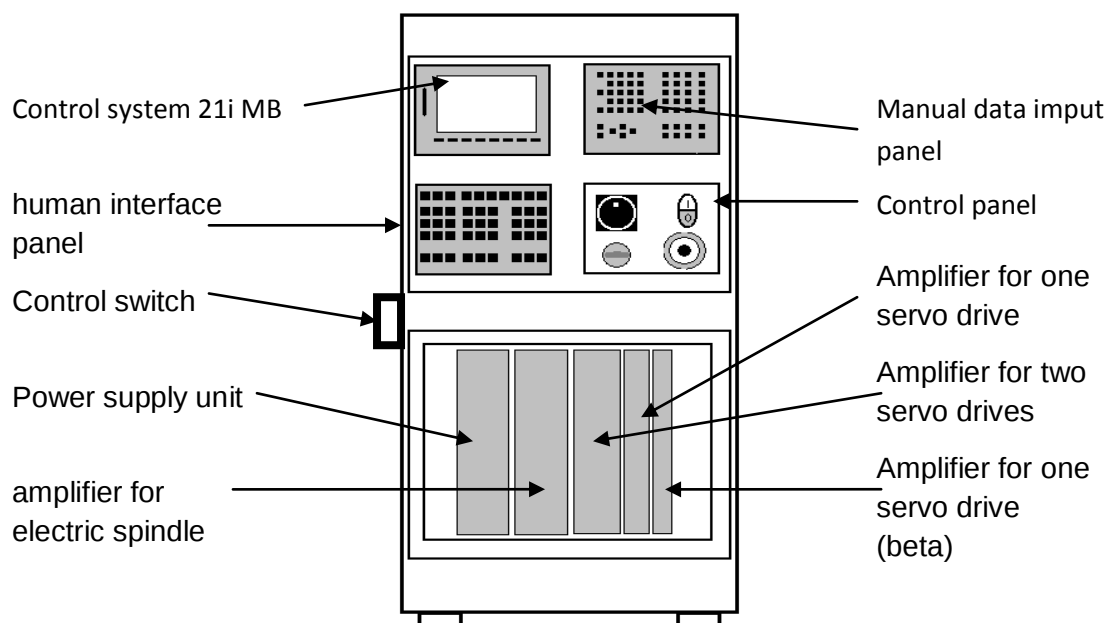
2.1 Support structure „table“

The support structure is made of BOSCH REXROTH 45x45 and 45x60H profiles connected with 30/30 angles from the same company. The X axis linear guide is fitted on the table using saddles. The guide is made of ROLLON Uniline A55 parts. There is a linear guide of Y axis attached on an X axis moving table. The Y axis guide is made of Uniline A40 driven by a servo drive and connecting elements. To balance the Y axis moment struts had to be used.

After cleaning and finishing the surface the struts serve as a support guide. Fiber-glass rings lubricated with oil were used as sliding elements to gain the necessary sliding and lubricating properties.

2.2 Case with electronics

The Case with electronics contains FANUC units mentioned above, control elements and necessary electronic and safety elements (switches, transformers, circuit-breakers, etc.) Thanks to its construction the Case allows a well-arranged and safe placing of cables and wires (prevents breaking fiber optic cable, damaging signal wires, etc.).



Pic. 1 - The Case with electronics

3. Current usage

Currently the stand serves as an educational instrument in CNC systems lectures, where thanks to its construction it allows an easy access to particular parts, which is necessary for a detailed explanation of CNC control systems functions and connections. Thanks to the front and back door of the Case and a sophisticated placement of particular components it is possible to access every detail of this system. The Case also allows an easy replacement or addition of components.

The only unused component is an electric spindle drive which is planned to be installed into the control system in an upcoming bachelor or master degree dissertation or in a PhD. dissertation on measuring gyroscopic effects in machining.

There is a bachelor thesis currently in process using this stand. The thesis deals with measuring arc interpolation precision. A milling machine compound table is used for purposes of this work. The table is driven by two identical servo drives mentioned above.

4. Safety precautions

Because the stand will be mainly used by students it was necessary to ensure safety. Safety precautions concern mainly person and property protection in a near vicinity of the machine but it also includes the machine safety and its damage protection.

Among protection elements belong traditional Emergency stop button connection, doubled end stops, which the inner one is a software end stop in NC section controlled by location signals derived from rotary encoder and an outer hardware end stop controlled by end switches and solved by a PLC (PMC) section.

Another important safety element is servo drives torque monitoring. This prevents a cause of injury or damaging people or property in the vicinity of moving parts of the machine. This safety precaution is very important mainly because of the absence of machine covers. Their absence is important for educational purposes. When the maximum torque of any drive is reached the drive is disconnected from control and it allows manual movement of the particular axis. The force that is needed for reaching the maximum torque is the force of one hand acting on any axis of moving part of the stand. Additional less important safety elements serve to limit the maximum speed and acceleration of the machine.

5. Conclusion

After completing the works the stand is fully functional, safe and it allows after necessary adjustments in a system to use it for other purposes. The stand has already been an instrument for lecturing for a number of times. The students were able to see the inner structure of the stand (mainly the Case) and they asked questions about the system's functions. Thanks to its simplicity the functions principles are clear, easily visible and therefore easier to understand.



Pic. 2 – Stand – Complet view

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