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MINI LATHE MACHINE CONVERTED TO CNC

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ABSTRACT

This paper presents the adaptation of a mechanical mini-lathing machine to a computerized numerical control (CNC) lathing machine. This machine is composed of a ASIST mini-lathe and a two-degrees-of-freedom XZ stage designed specifically for this application. The whole system is controlled from a PC using adequate CNC control software.

Keywords: CNC lathing machine, stepper motor, stepper driver, Mach 3 soft, PID regulator

1. Introduction

The lathe is a mechanical machine used to create cylindrical shapes on a turning object.. The first depiction of a lathe was discovered in a well known Egyptian wall relief carved in stone in the tomb of Petosiris dated some 300 BC. They appeared out of the necessity to create round shaped objects like the axis, spokes and hubs for wheels. This paper presents what can be accomplished using modern CNC equipment to extend and improve the capabilities of a foot lathing machine.

For this application we used an ASIST AC4s50n mini-lathe (Fig. 1).

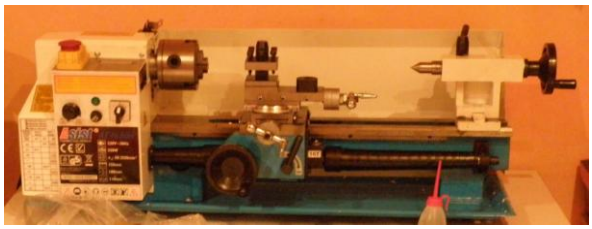

Fig. 1- The ASIST mini-lathe

To achieve a greater precision of the lathe, the lead screws were exchanged with two induction hardened 16mm diameter ball screws to increase the accuracy and repeatability. The longitudinal lead screw was not reconnected to the gearbox instead it was connected to a stepper motor on the other end via a coupling. The transversal screw was also replaced as mentioned and a stepper motor was installed instead of the manual adjustment system also via a coupling. The nuts used for both lead screws were special ball nuts. There have been some elements especially designed and created to mount and fit the new components such as the stepper motors, the couplings and the ball nuts.

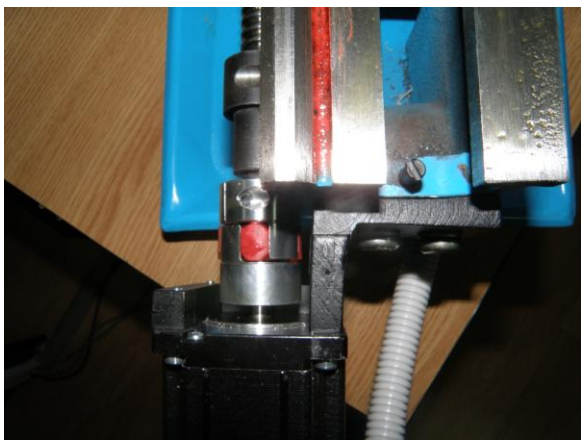

Fig. 2 -The mounting of the longitudinal motor and coupling

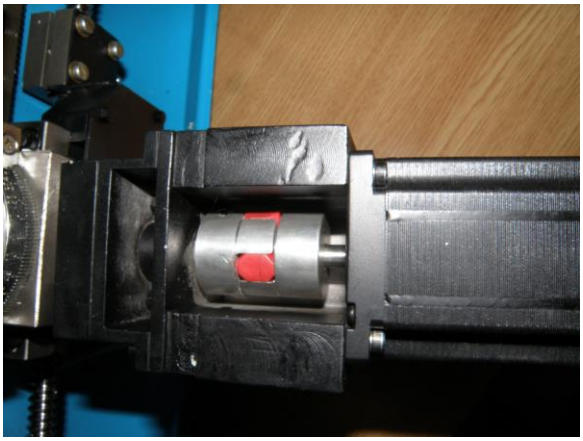

Fig. 3- The mounting of the transversal motor and coupling

For the mounting of the transversal lead screw a more special mounting was needed since it did not fit thro the original hole and it also needed extra support for precision and so it was mounted and fitted on a frame that included two bearings (Fig. 3).

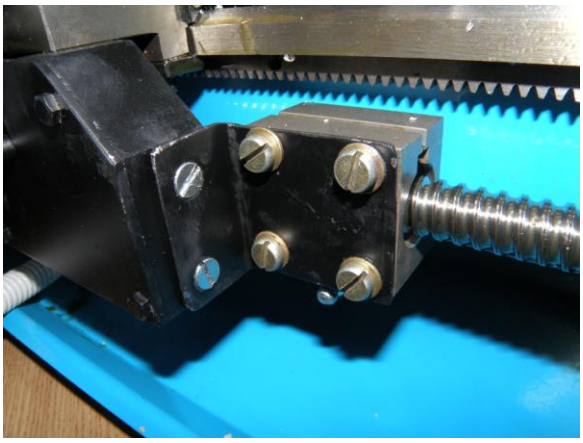

Fig. 4- The linear translation stages

For this application the ZAPP Ltd. SY60STH86-3008BF stepper motors proved to be adequate. The motor is a 1.8 degrees/step stepper motor which provides a holding torque of 3Nm in bipolar parallel wiring, for both axes.

2. Stepper Motor Driver

The stepper motors are driven by a stepper motor driver. The stepper motor driver is an electronic equipment which provides an interface between a step pulse generator (in this case a PC) and the stepper motors. The POWER STEP PSD5042-2P is a single motor controller unit that can control in bipolar micro stepping mode. The driver can control a wide variety of stepper motors (24-50V and 1- 4.2A) in full, half, quarter and 1/16 micro stepping resolutions. The current limit and the micro stepping are adjustable by dip switches. The driver requires a minimum of 24V DC and accepts a maximum of 50V DC and is connected to a PC via a small centralizing board to the parallel port.

For this application we used a professional a Mean Well SP-320-36 320W, 36V DC CNC power supply. The stepper motor driver and the power supply assembly can be seen in figure 5.

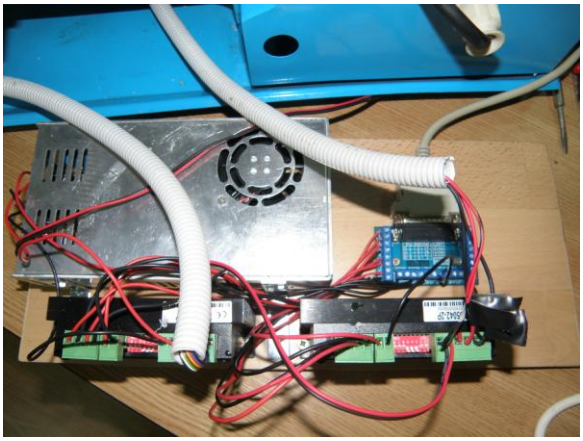

Fig. 5- The driver and the power supply

3. Control software

To create different models for the machine, items can be created in Autodesk inventor and then saved in a format that can be opened with a ArtCAM program to create a G code for the Mach3 CNC interface program.

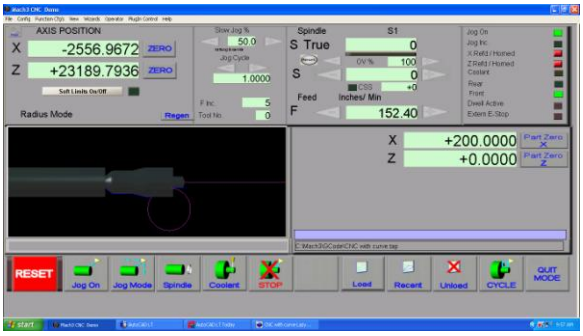

Fig. 6- Mach3 program interface

Fig. 7- The CNC lathing Machine

4. Experimental results

A part of the experimental research was performed in Power System Control and Robotics Laboratory from the Engineering Faculty, "Petru Maior" University of Tirgu-Mures. The general view of the CNC lathing machine is shown in figure7.

The purpose of the experiment was to determine the optimal micro stepping modes for the, the accelerations and the maximum speed for the stepper motors, and also to determine the productivity of the machine by determining the maximum and the optimum lathing speeds. Also the experiment helped to determine what materials can be worked.

5. Conclusions

We managed to prove that it is possible to create a CNC lathing machine, and that it is also possible to extend the capabilities of the classical lathing machine to create complex shapes like round or ball like surfaces.

This design can be improved by using an incremental speed gage connected to a PID regulator to stabilize the speed of the main axel to ensure a constant turning speed of the material.

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