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EMT 2540: PRACTICAL REPORT I

CNC MACHINING

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1 Introduction

1.1 CNC Machining

Numerical Control (NC) uses a processing language to control the movement of the cutting tool or workpiece or both. The programs contain information about the machine tool and cutting-tool geometry, the part dimensions (from rough to finish size), and the machining parameters (speeds and feeds and depth of cut). Onboard microprocessor which can be directly controlled gives rise to Computer Numerial Control (CNC) Machines.
Controlling CNC machines using variable inputs via a computer program is known as numerical control. The system automatically interprets some parts of the program in order to plot the tool control to create the desired part according to the NC program.

1.2 Objectives

1. To design a program to create a part using CNC Machining.
2. To program the CNC Machine tool.
3. To create and examine a part made from the CNC Machining process.

2 Literature Review

2.1 Numerical Control in Machining

Numerical Control (NC) is a non-conventional machine control method. A computer program is used to control the machine tool rather than a human operator manually controlling the machining parameters such as the speeds, feeds and depth of cut, as well as the part dimensions. Repeatability and quality are greatly improved over conventional machines. The use of NC machines also reduces non-machining times, such as setup times, tool change times and change of cutting speeds and feeds. It also relieves the operator of tasks such as changing machining parameters(cuttingg speeds and feeds), and locating the tool relative to the work. Even the most simple NC forms, and digital readout equipment, provide much greater accuracy and productivity.

2.2 CNC Machining

Computer Numerical Control is an NC method where an onboard microprocessor is directly programmed to control the machine tool. Early NC machines used punched cards for control, while CNC machines use software programming to achieve the machine control.

2.2.1 The CNC Machining System

The main components of the CNC system are shown in Fig. 2.1. These components include:

1. The Machine Tool Unit - This is responsible for the extrication work. It consists of the tools to be used, the attachment mechanism, the spindle and all moving parts involved in machining.

2. The Machine Tool Drives - Classified as either spindle or feed drives.

   (a) Spindle drives rotate over a wide range of velocities, measured in rpm.

   (b) Feed drives convert angular motion of the motors to linear transverse speeds, measured in mm/min.

3. The CNC unit - Runs under a program known as the CNC executive which translates programs written in internationally recognized standard language.

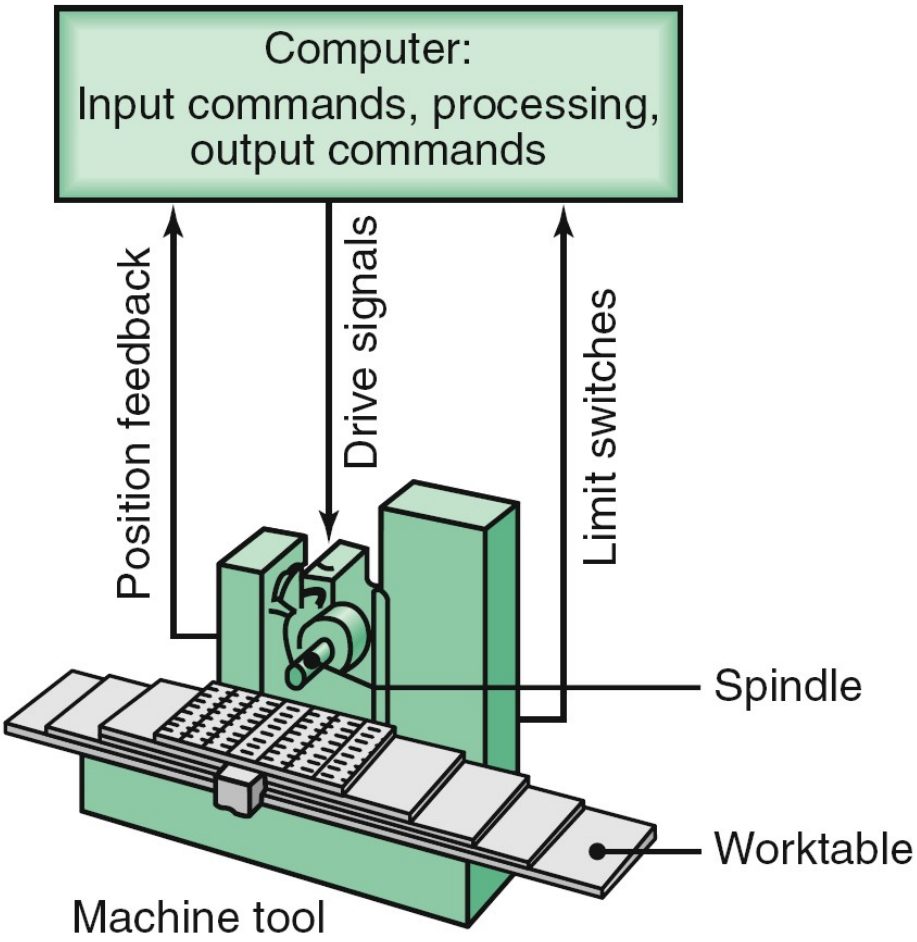

Figure 2.1: CNC Machine Table Location Schematic

2.2.2 CNC Machining Process Parameters

The CNC Machining Process can be used to machine The performace of a CNC Machining operation is determined by a number of properties:

1. Material Removal Rate (MRR)
2. Surface Quality
3. Accuracy

These are determined by the process parameters such as:

- Pulse characteristics
- Workpiece properties - ductility, hardness, grain formation
- Use of cutting fluids such as
- Dielectric properties
- Tool electrode - material, movement, wear

2.2.3 Applications

CNC Machining can be employed in:

1. Micro-EDM: Micromachining of holes, slots and dies.
2. EDM drilling - creation of cooling channels in turbines made of hard alloys.
3. Electrodischarge sawing where billets and bars are created.
4. Machining spheres, dies and moulds.
5. EDM of ceramics used in insulation.
6. Texturing - texturing is applied to the steel sheets during the final stages of cold rolling.

2.3 Other NC Machining Processes

Numerical control has been applied to a wide variety of other production processes[1], some of which are listed below

1. NC Punches - Numerical control is used for X-Y control on the table.
2. CNC Wire EDM Machines
3. Laser and water-jet abrasive machining
4. Flame cutters

2.3.1 Advantages and Disadvantages of Numerical Control

Numerica Control has several advantages as compared to other conventional methods of control[2], some of which are:

1. Higher production rates, productivity, and product quality; greater operational flexibility; the capacity to make complicated forms with good dimensional precision and repeatability; and reduced scrap loss.
2. Making machine adjustments is simple.
3. With each setup, more operations can be completed, and the setup and machining lead times are less than with traditional methods.
4. Programs can be quickly created and retrieved at any moment.
5. The level of operator skill needed is lower than that of a skilled machinist, giving the operator more time to focus on other activities around the workspace.

Some of the major limitation of NC machining are:

1. Initially expensive cost of the equipment.
2. The cost of programming and the price of computer time.
3. The unique maintenance needed.
4. Preventive maintenance is essential since these equipment are complicated systems and breakdowns can be expensive.

3 Methodology

The equipment needed and procedures undertaken to carry out CNC Machining are described in the following sections. The experiment was done at ENW-04 (Machine Shop) at the JKUAT Workshops.

3.1 Equipment

1. CNC Machine ()
2. Workpiece design as specified by the manual
3. CNC Machine controller (Siemends Sinumerik 828D)
4. Workpiece - Aluminium block

Figure 3.1: CNC Machine Controller - Siemens SINUMERIK®828D

3.2 Procedure

Prior to beginning the machining operation, the machine has to be checked for the required items for its functionality, namely:

1. Oil - This is necessary for lubrication and is contained in an oil tank at the back of the machine.
2. Air - the pneumatic system is used by the tool change mechanism, and is supplied via high-pressure pipes and air ducts from an air compressor.
3. Electricity - 3-ϕ electricity is required for the machine drives to move the various axes along.

The shape to be created was analysed and the dimensions obtained. A toolpath was created using G codes to control the EDM Machine. The codes were programmed into the EDM Machine.
Once the program was loaded in the machine, the wire electrode was carefully placed at a small distance from the edge of the workpiece. The pump was then turned on and the dielectric fluid, in this case water, was used to fill the dielectric tank. Once the water level reached the trigger floaters, the machine was ready to begin the machining process, thus was turned on and the machining process done.
Once the machining process was completed, the tank was once again drained and the workpiece retrieved for examination.

3.3 EDM Machining Program

The program used to machine the workpiece was handwritten and then transferred to the EDM Machine Controller. The program is as follows:

Figure 3.2: CNC Machining Process Underway

4 Results

The machined part was created and can be represented as in Figure 4.1

Figure 4.1: The Machined Part

5 Discussion

5.1 CNC Machining

The machining operation was successfully carried out and the workpiece retrieved. G- and M- codes were used in manual part programming. These codes are specific to the CNC machine and are specified by the manufacturer.

References

[1] J. T. Black, *DeGarmo's Materials and Processes in Manufacturing.* John Wiley & Sons, 2011.

[2] S. Kalpakjian, *Manufacturing Engineering And Technology.* Prentice Hall, 2010.