REVIEW AND ANALYSIS OF THE METHODS FOR
CNC - PROGRAMMING

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Keywords: analysis, methods, CNC-machines, CNC-programming, wood

ABSTRACT:

This thesis examines the methods for CNC-programming, which we will review and analyze. Mainly, the division of CNC-machines is reduced to vertical machining centers, horizontal machining centers and machining centers with variable axes. The basic parts of CNC-system are working spindle, working table and device for tool changing. The methods of programming CNC-machines are: manual programming, machine (semi-automatic and automatic) programming, graphical programming simulation process of slicing and programming with CAD-system. Practical example of CNC-program.

1. INTRODUCTION

Computer Numerical Controlling (CNC), Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM), nowadays provide leading position in the industry which have revolutionary changed the way of machines production.

CNC-machines use a computer built into them as controller, have more features than programmable NC-machines and they can be used as independent units or as a network of machines such as the flexible machining centers.

Most of the machines with numerical control are machining centers for milling, drilling and grinding. With their growing popularity they covered more than half of all numerical controlled machines on the market. It has also created revolutionary technological changes and the necessity to educate engineers / technicians with full knowledge for this type of machines.

2. BASIC CHARACTERISTIC OF CNC-SYSTEM

Vertical machining centers represent numerical controlled systems for automatic tool change to improve the processes of processing.

Figure 1. Vertical mill

Horizontal machining centers are horizontal milling machines with numerical control. Their main purpose is processing large timbers especially making deep cuts. They are equipped with devices for automatic tool change.
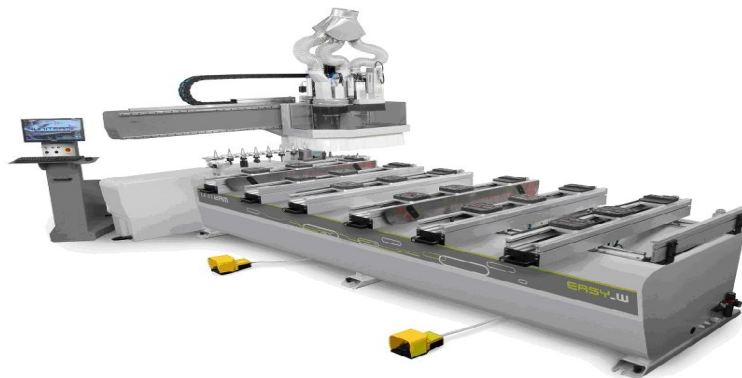

Figure 2. CNC-machine (horizontal machining)

The machining centers with variable axes, provides simultaneously processing in six different directions. The change of axes in different directions allows the positioning of the tools in any direction.

Figure 3. CNC-machine (center for 3D machining)

The basic characteristic parts of a CNC-system are: working spindle, working table and device for tool changing.

3. REVIEW OF THE METHODS FOR CNC - PROGRAMMING

The group of important and economical methods for managing the CNC-machines consists of:

- Manual programming
- Machine programming
- Graphical programming of simulation process of cutting CNC-machines and
- programming with CAD-system

3.1. Manual programming method

Manual programming is based on the technical-technological drawing and using a calculator. In this method the programming of all geometric and technical parameters are realized by the programmer.
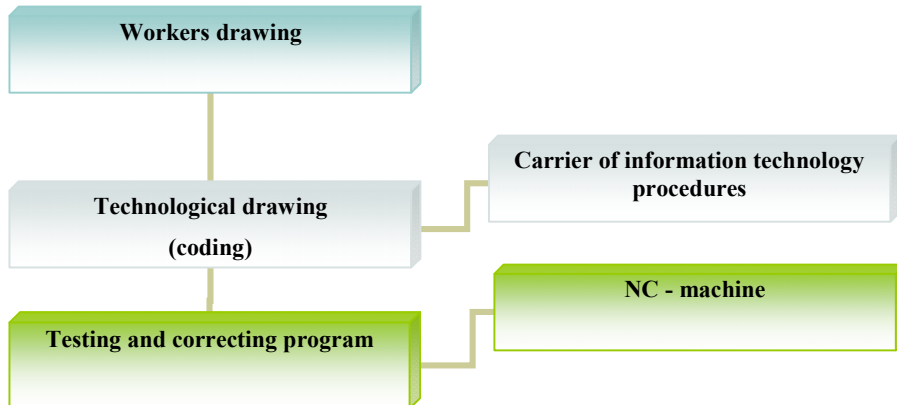
Figure 4. Manual programming of numerical controlled machine (NC-machine)

3.2. Mechanical method of programming

The mechanical method of numerical controlled machines in the developmental period reaches a higher degree of automation. This means that the automation of the programming is approaching a quantitative and qualitative higher level of preparation of the program for CNC-machines. Automatic programming uses problem-oriented languages and processors such as APT, COMPACT, ELAN, GTL. Depending on the degree of automation of the projected technological process, programming can be:

- Semi-mechanical programming or
- Mechanical programing

3.3. Programming of graphical simulation for the process of cutting CNC-machines

The microprocessor in each machine, loads a program represented in G-code, which is created by the user and performs specific operations. Programs are created manually with writing G-code and using CAM software (Computer Aided Manufacturing). The application field of the CNC-machines is large and includes among others:

- Wood processing
- Metalworking
- Plastic processing
- Engraving
- Modeling
- Tool development etc...

3.4. Programming with CAD-system (Computer Aided Design)

Programming with CAD-system procedure is done in two ways.
The first model of linking is reduced to a situation that allows the use of already existing work programs.
The second model of linking the CAD-system with NC-programming allows the description of the object for processing in the form of NC-managing information.
CAD-system supports different ways of motion of the tool as:

- Dotted management (wood drilling)
- Milling (two directions along x and y - axis)
- Leveling (two directions along x and y - axis)
- Processing of external surfaces (three directions x, y and z - axis)

4. REFERENCE POINTS OF THE MACHINE AND THE TOOL

- W - zero point of the object for processing. It can be changed if is needed.
- M -zero point of the machine. The position of this point does not change. It is determined by the manufacturer of CNC-machine. From this point all movements of the tool are analyzed.
- N -reference point of the tool. It lies on the axis of the tool and does not change.
- R -reference point. Point of reference to start the tool.
- B -starting point. From point B the tool begins with processing the object (wood). At that point the tool is changing. It is not necessary to be defined.
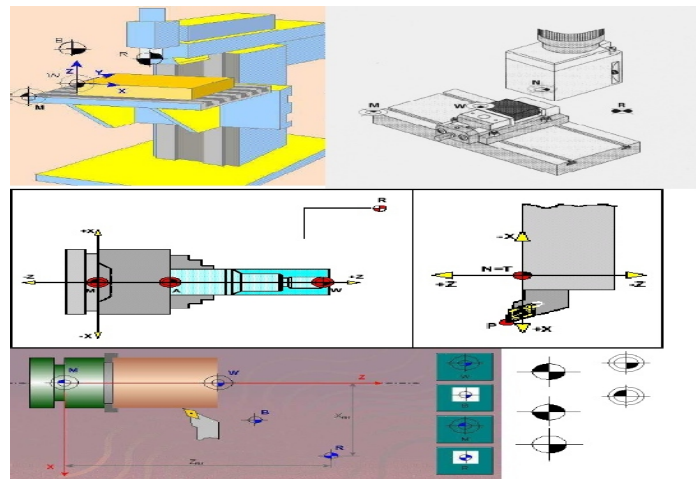
5. OPPORTUNITIES AND APPLICATION OF CAD-SYSTEM

Some of the most opportunities of the CAD-system are:

- Modeling in 2D and 3D
- Automated design of complex products
- Development of technological schemes
- Preparation of technical documentation
- Simulation
- Finding the optimal solutions
- Transferring data directly to industrial machines etc...

The application of CAD-system can be established that there is a wide field of use. Significant areas are: wood industry, construction, mechanical industry, energy, electronics and telecommunications, textile industry, food industry etc...

6. CONCLUSIONS

1. Modern CNC-machines operate on the principle of reading over a thousand bits of information entered into the program memory of the computer.

2. The main division of CNC-machines.

3. The methods of programming of CNC-machines are:
- Manual programming - which is used in older models of NC-machines.
- Machine programming. According to the degree of automation it can be: semi-automatic and automatic programming.
- Programming of graphical simulation of the process of cutting CNC-machines. Used in the field of wood processing, plastics processing, engraving, modeling tool for development etc.
- Programming with CAD-system (Computer Aided Design). CAD-system or computer helped design supports different movement of the tool, which allows drilling of the wood, milling, leveling and processing of external surfaces in X, Y and Z - axis.

4. In the field of wood industry the CAD-system is used for:
- Industrial design
- Wood processing (cutting, drilling, milling, etc.).

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