

## ASPECTS REGARDING THE PROCESSING OF COMPLEX SURFACES FROM WOOD

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### RESEARCH ARTICLE

#### Abstract

CNC machines have gradually replaced the classic, manually operated ones, allowing the performance of various operations, specific to industrial production processes. The CNC machine interface is easy to learn and use, providing the ability to simulate machine operation. Through advanced software programs, CNC machine tools enable the creation of products that are difficult to design using traditional methods.

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#### INTRODUCTION

Every CNC machine has two or more directions of motion, called axes. These axes can be precisely moved and precisely positioned throughout the travel range.

The most common types of axes are linear and rotary. Instead of producing these movements with the help of an operator, through the use of cranks and discs, as required by classic machining machines, CNC machines are driven by computer-controlled servomotors and guided by a memorized program. In general, the movement type, axes, movement distances and machining speeds are programmable.

CNC machine tools can be used continuously, increasing productivity and providing greater control over industrial processes ([meproulaj.ro](http://meproulaj.ro)).

Unlike classic lathes or milling centers, CNC machine tools do not require a high degree of operator expertise. The research for this paper was carried out at a company in the field of wood processing in Sighetu Marmației, between January 2022 and May 2022.

#### MATERIAL AND METHOD

Wood in general allows fairly easy processing on CNC machines, so it is widely used for milling, cutting and turning. In addition, it is a relatively cheap and abundant material. On the other hand, it is usually one of the most used

materials also for home CNC machines used by some DIY makers and hobbyists.

Classification of CNC by their axes.

Due to the higher number of axes, CNC machines have more freedom of movement and more variable part processing complexity. (hwlibre.com, Derecichei L. et al., 2013, Derecichei L. et al., 2017, Derecichei L. et al., 2018).

CNC machines with more than 5 axes

In addition to 3, 4 and 5 axes, there are types of CNC machines with more axes, even up to 12.

These are more advanced and expensive machines, although not as common. Some examples are:

7 axes: Long, thin parts with many details can be made. These types of CNC machines have axes for right-left, up-down, back-forward, tool rotation, workpiece rotation, tool head rotation, and work clamp movement.

9-axis: This type combines a lathe with 5-axis machining. The result is that it turns and mills along multiple planes with a single setup and with high precision. In addition, it does not need secondary accessories or manual charging.

12 Axis: They have two VMC and HMC heads, each of which allows movements in the X, Y, Z, A, B and C axes. These types of machines offer improved productivity and precision. The way these machines work is shown in figure 1.

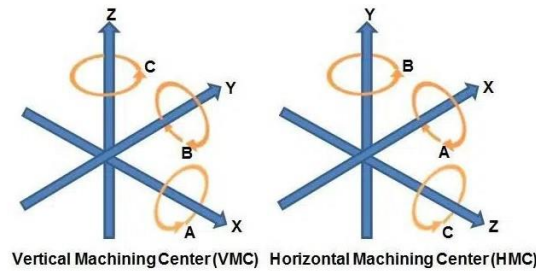


Figure 1 Working CNC with 12 axes ([hwlibre.com](http://hwlibre.com))

NX CAM shown in figure 2 allows for simplified CNC programming and the execution of work instructions together with the CNC program, the document being automatically generated by pressing a button (Derecichei L., 2020, Lucaci C., et al., 2013, Lucaci C., et al., 2015, <http://www.digitaltwin.ro>).

The advantages of this way of working are:

- the work instructions are created as an integral part of the CNC program in the NX CAM file, thus simplifying their management and making unnecessary the use of additional text editing software (such as Microsoft Office);

- updating the work instructions is done 90% faster thanks to the associativity with the CAD reference and the CAM program;
- both the steps performed on the CNC and the additional steps can be documented;
- publication can be done in PDF or HTML format;
- the creation of new work instructions can be done quickly and consistently through configurable templates;
- a procedural and unitary way of working is established.

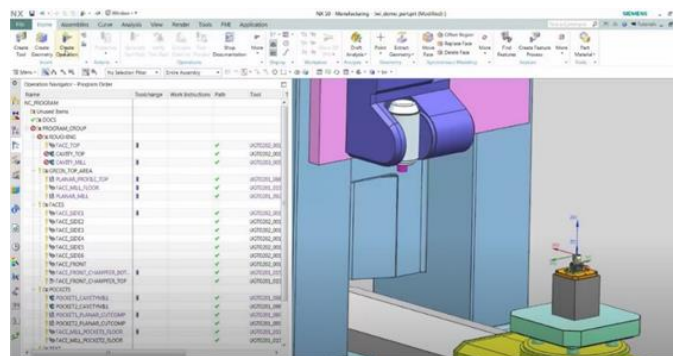


Figure 2 Programming with NX CAM ([digitaltwin.ro](http://digitaltwin.ro))

## RESULTS AND DISCUSSIONS

Processing of complex wooden surfaces is done on CNC machines.

In addition to the programming of CNC machine tools, the execution of the reference by G/ISO program described above also involves knowing the operating functions on the control panel of the CNC machine and a series of preparations before starting the automatic machining processes for example:

- manual, automatic operation;
- the system for clamping elements to be processed;
- zero set – setting the zero point;
- setting the tools;
- the collision avoidance system.

Some CNC machines allow simulation of the machining process at high speed, thus

avoiding possible problems that can interrupt the cutting and later changes can be made in the program lines (Derecichei L. et al., 2018, Derecichei L. et al., 2020).

The processing of complex surfaces can be done through a first work phase, or through a previous roughing or pre-drilling phase, because the differences are too large differences between the raw part and the part we want to make, or processing with a single pass would affect the quality of the final part (tehdn-design.ro). An example of roughing of the part to be subsequently passed through a final finishing phase is shown in figure 3.



Figure 3 Machining with CNC 5 axes ([tehno-design.ro](http://tehno-design.ro))

When processing several parts from a piece of material, you can opt, as in this example from figure 4., for some neutral portions called "bridge portions", some connecting portions

that remain for fixing the parts until the processing is completed, after which they detach from each other (<http://www.cnc-3d.ro>, Ganea, M., 2010).



Figure 4 CNC milling (bridge finishing) (<http://www.cnc-3d.ro>)

On this machine, 2 motors are mounted, shown in figure 5., on a single arm controlled on axes A and C, each with 2 heads for tools which gives a very high speed when changing

operations. The two motors have a power of 7.5 kw each, with the help of the two inverters (<http://directindustry.com>).



Figure 5 Chuck motors ([directindustry.com](http://directindustry.com))

Fixing the landmarks can be done both with the help of pneumatic and vacuum clamps.

Figure 6 shows vacuum clamping on special templates.



Figure 6 Fixing the landmarks through the vacuum system ([directindustry.com](http://directindustry.com))

The position of the X-axis above the work tables gives a very high flexibility because the CNC arm can work in front of the table, to the side of the table, behind the table, above the table and under the table.

The clamping tables can move on the X and Y axes, which gives it an asset for series production and small milestones.

The circular cloth has the characteristics of outer diameter 230 mm, Z=40, n= 6000 rpm.

For cutting speed:

$$v = \frac{\pi \times D \times n}{1000 \times 60} = \frac{\pi \times 230 \times 6000}{60000} = 72.22 \text{ m/min}$$

So we will be able to use a maximum cutting speed of 72 m/min.

The main program that Velox duet CA works with is E-lab.

E-Lab is a program of the newest generation and is updated every day to the requirements of customers and their needs.

In the E-lab program when we work, we must forget about those ISO codes made in notepad or generated in other programs without any graphic interface and imported into the machine program.

The realization of a new project is presented in figure 7 and figure 8.

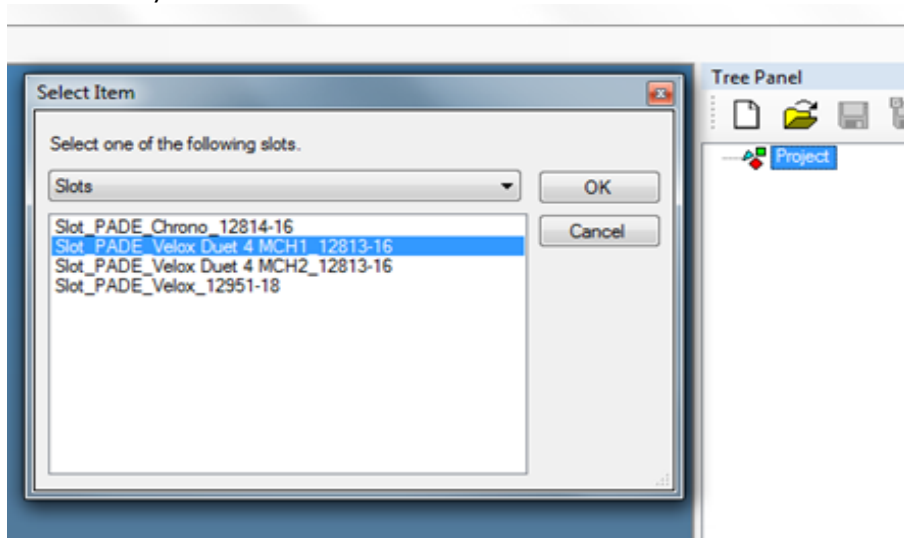


Figure 7 Select slot (woodworking company)

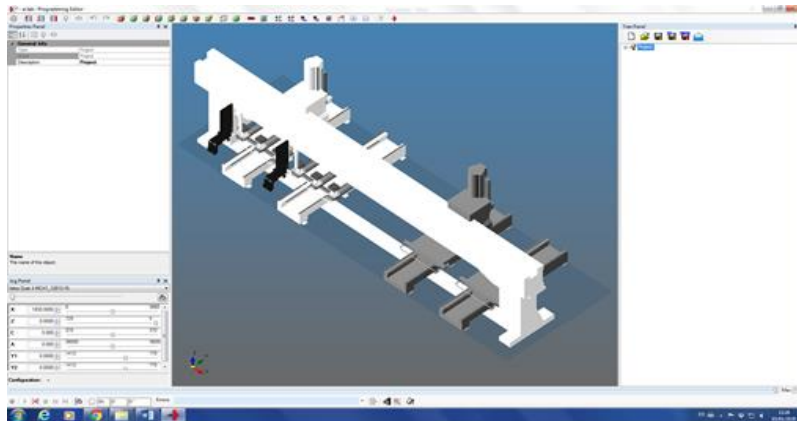


Figure 8 Choosing the area to work on (woodworking company)

You can choose to work with both tables at the same time (it is used for large landmarks like table tops) and work on each table with a different landmark (on table 1A with the front-left leg and on table 2A with the back-right leg).

A 3D design program (eg Solidworks) can be used for the model and a program for creating operations with the help of the machine's post-processor (eg AlphaCam) can be used to process these landmarks. Example of a completed program figure 9.

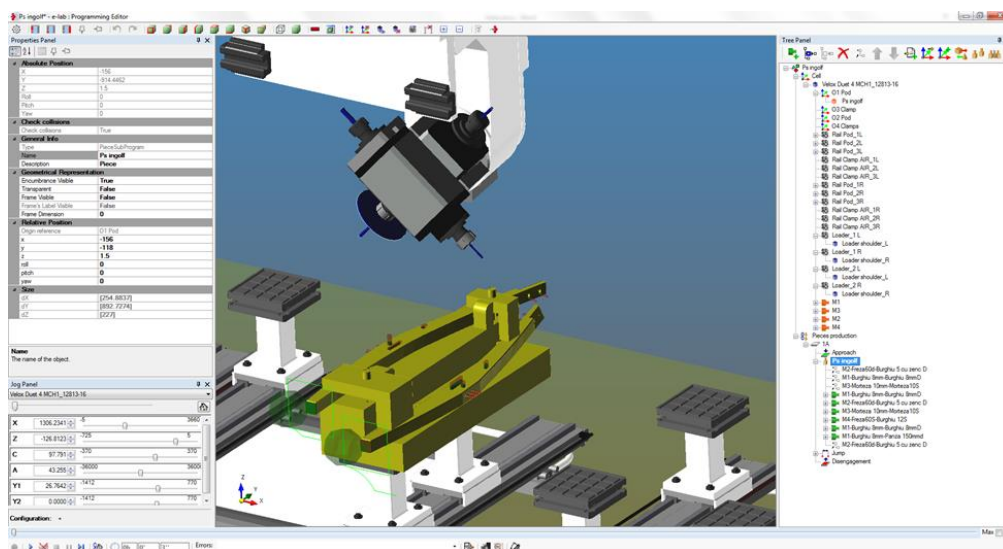


Figure 9 Program made on CNC Velox (woodworking company)

## CONCLUSIONS

The programming of CNC machines is often done manually or assisted by a graphical conversational interface, in the case of the present work, "E-lab", an interface that is much easier to use for defining and modifying the

processing parameters of complex wooden surfaces.

Modular milling cutters can be used to make marks with complex surfaces, which brings an advantage for the time of making marks much shorter, a very important thing to which we have contributed to increase production in the production hall.

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