The use of CNC machines in development of modern furniture

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Abstract

English

Key words: Wood industry; CNC machines; Woodworking; Modern industry; Modern furniture

In this paper it will be write about using CNC machines in wood industry, because with the progress of wood industry there was a need for CNC machines. That kind of technology represents faster and more accurate woodworking. When it comes to modern industry it is unthinkable without the use of CNC machines. These machines are increasingly used in industry because of the many advantages over conventional machines , some of the benefits are: great precision, quality and processing speed, the processing of complex parts. We can use CNC machines to create modern furniture because besides the functionality the design is very important and we can achieve that with this technology.

Bosnian

Ključne riječi: Drvna industrija; CNC strojevi; Obrada drveta; Moderna industrija; Moderni namještaj

U ovom radu pisati će se o upotrebi CNC strojeva u drvnoj industriji , s obzirom da se napretkom drvne industrije pojavila potreba za upotrebom CNC strojeva. Takva tehnologija predstavlja bržu i precizniju obradu drveta. Kada se radi o modernoj industriji ona je danas nezamisliva bez upotrebe CNC strojeva. Ti strojevi nalaze sve veću primjenu u industriji zbog velikog broja prednosti koje imaju u odnosu na konvencionalne strojeve, neke od prednosti su: velika preciznost, kvalitet i brzina obrade, obrada složenih oblika. Jedna od primjena CNC strojeva jeste za izradu savremenog namještaja s obzirom da je pored funkcionalnosti bitan i izgled a to se lako postiže upravo ovom tehnologijom.

1. Introduction

Computer numerically controlled machines (CNC) are now used in almost every industry. The first CNC machine was developed in 1951 in the United States, and in 1969 CNC machines became available in wood industry. The introduction of CNC machines radically changed the wood industry. They are far more effective, but also more popular than drill and milling machine mainly due to its flexibility. The main advantage of CNC machines is possibility to perform more operations uninterruptedly without addition modifications and settings, and therefore errors are almost impossible. There are more advantages of CNC machines and one of them is that this kind technology is safer than milling cuter, circular saws and many more, because worker is not so much in touch with the working process. Modern CNC machines operate on the principle of reading thousands of bits of information stored in the program memory of computers. To save all the information the developer creates a set of instructions that a computer can understand. Encoded commands are most common method of programming a CNC machine tool. CNC machines are significant in development of modern wooden furniture. Because of its beauty, quality, simplicity in use and cultivation and a high level of environmental standards, wood is the most important material used in construction, both in the exterior as well as interior. Wood is a natural and renewable material. This is the material that appears in various forms and is present in all styles of design, from modern minimalistic to luxurious style. The main reasons for its frequent application is that it creates a feeling of comfort and warmth, and space makes an elegant and refined. It can be used as different types of coating: wall, floor, ceiling and furniture making, carpentry, doors, windows, and different everyday little things for the home.

2. CNC machines

Abbreviation CNC means Computer Numerical Control (computer numeric control), and refers in particular to the computer 'control' that reads the instructions of the production code and that moves machine tool. NC is numerical control and it began to develop in late 1940s and early 1950s in company MIT Servomechanisms Laboratory in USA. The CNC was created from NC systems which already have been developed. First CNC systems used NC hardware style, and computer was used for calculation and sometimes for editing tool calculation. The use of punched tape as the transfer medium for G-code started in early 1950s until the late 1970s. Later it was replaced with floppies (disks), and finally today for those operations a standard computer network is being used. The first NC machines have appeared in the beginning of the 50s of last century in the US. The main objectives, which they wanted to achieve were:

- increase productivity,
- improve the quality and accuracy of production,
- reduce production costs,
- enable production of more demanding products, which otherwise can’t be done.

With the development of electrical engineering, especially electronics, machines are physically changed, offering greater processing capabilities. By adopting the highly automated CNC machines, speed and accuracy of production are being increased and production costs are lower. The great evolutionary leap was a switch from the NC control on CNC control, where the computer takes over the management. Compared to the manual machines, the advantages are enormous:

- simple modification and reparation of given task
- greater productivity
- great quality and accuracy of workpiece
- high flexibility in processing

Introduction of CNC machines radically changed the manufacturing. Curves is now cut out easily as straight lines, complex three-dimensional products (reliefs) are relatively easy to

produce, and the amount of mechanical operations, which previously required considerable human labor, has dramatically declined - machines began to "work alone" and they are never tired. With increased automation of production with CNC machines also increased precision and quality of products. CNC production has reduced the number of waste and increase the speed and flexibility of production (flexibility - all can be done), the number of manual workers has decreased, and the need for highly educated professional staff has increased. In this way, the production costs are drastically decreased. Newer technology - cheaper production. In production environment, a series of CNC machines can be connected in one - the so-called CNC station. Today we can manage CNC machines with files from one of CAD softwares, starting from the design of product. CNC machines are in some way part of robots industry because they can be programmed to do many operations, just like a robots can. CNC machines can work during the night and weekends without the presence of people.

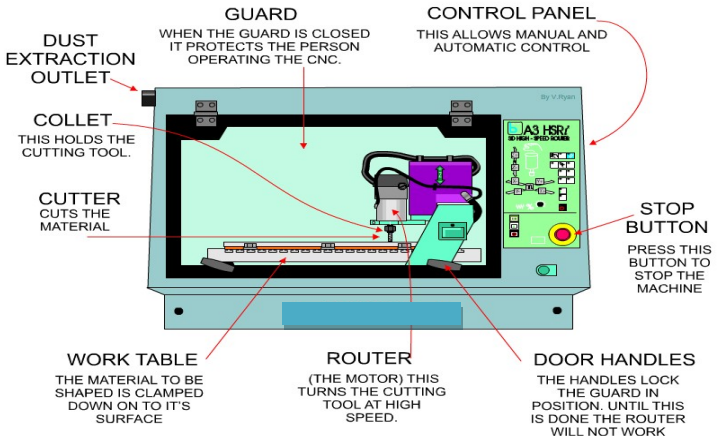

Figure 1. Example of CNC machine with its parts

2.1 CNC machines for making wooden furniture

Computer technology is responsible for the revolution in the field of inventions and technology. It has made work faster, accurate and reliable. Now we can achieve all our ideas due to this technology. The wood working industry has also experienced amazing designs and fine woodworking patterns due to the blessing of computer technology. Now we can make any design with the help of machines. **CNC woodworking machines** have proved their worth. These machines are widely used in the wood working industry. CNC woodworking machine is managed by the control unit as well as CNC machines for metal processing, but differences are the following:

- Motors of CNC woodworking machines usually revolve at higher speeds than the CNC machines for metal, one of the reasons for that is because during the higher speed we get better quality of wooden products, and we get greater productivity
- A wood router is controlled in the same way as a metal mill, but there are CAM and CAD applications such as Artcam, Mastercam, Bobcad, and AlphaCam, which are specifically designed for use with wood routers.

Another difference between the CNC machines for woodworking and metalworking is their size. Size of CNC machines for wood is generally much higher than those for metal because of the products intended to be made of wood. These are for example products such as parts of beds, room closets, kitchen cabinets and the like. One of the most commonly used CNC machines are CNC milling machines and they can be divided on the basis of their working dimensions and it depends on which part of the furniture is produced at those mills, but rough division CNC milling machine to work dimensions is:

- small CNC milling machines: aerial dimensions to 400x400mm,

- middle CNC milling machines: aerial dimensions to 1200x1200mm,
- big CNC milling machines: aerial dimensions to 2000x3000mm.

Figure 2. CNC milling machines of different sizes

There are also universal CNC woodworking machines that are in the context of furniture used in the production of several different types of products. Such machinery should ensure that the switch from one type of treatment to another is easy and fast. Machines like that should ensure universal way of accepting or fixing workpieces and quick and efficient exchange more or less universal processing tools. Tools on such machines are usually used in more types of treatment. For example, a specific cutter can be used in processing the table legs as with processing the chair. In general, universal CNC machines can be easily adapted to the required process and desired product.

Figure 3. Processing of parts on universal CNC machine

Figure 4.CNC machine for doors

Specialized CNC woodworking machines are facing production with usually one type of product inside which they can produce different types of products. Such machines have specific features, either in terms of approaches to the workpiece or the type of tools that are used. Generally it should be noted that the specialized CNC machines use a limited number of different types of processing. As an example of specialized CNC machines can be named those for the production of windows, door frames, machines for coating edges and others.

3. CAD/CAM software

Modern furniture began to develop back in the 19th century under the influence of modernism in art and developed ever since. With the advancement of technology furniture design has progressed , and application of the above mentioned machines furniture design has barely any limits. CNC machines allowed us faster production of furniture with less unused material and enable the production of complex furniture, and one of the best things is that we can first construct furniture in one of the CAD software. Most software packages is 3-D, because it is a new generation of CAD software packages for design. Engineers in this way can create virtual models of their projects or products. This significantly speeds up the process of work, because they are able to control production and by using 3-D software we can drastically reduce the number of production errors, which may occur when viewing tolerance, which can significantly reduce production costs, because there is no large unused material, while design process becomes a competitive advantage. 2-D software can be effective when we produce parts that are not complex. Simple and easy we can convert an

object into CAM. The most famous 2D software packages are: AutoCAD and MicroStation. The most famous 3-D software packages are: CATIA, Inventor, TopSolid, SolidWorks, Alibre Design.[2]

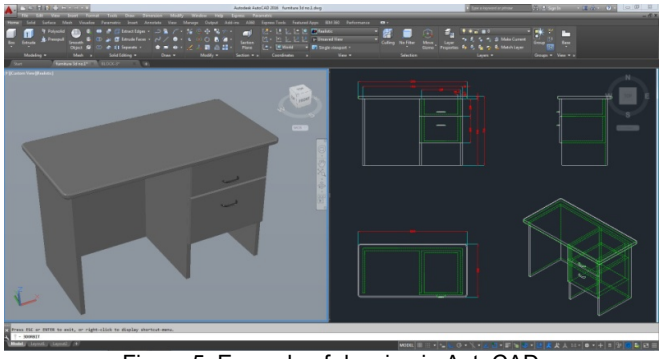

Figure 5. Example of drawing in AutoCAD

CAM is an acronym for computer-aided manufacturing / processing (Computer Aided Manufacturing). It was developed at the same time as the CAD. Sometimes CAM applications are integrated with CAD and that is a software package called CAD / CAM. Most popular CAD / CAM) softwares are: ESPRIT, Surfcam, RhinoCAM, ArtCAM, AlphaCAM, SheetCAM. G-code is defined and generated by CAM software. G-Code is a simple text commands, which are used for understanding of CNC machines. It is good to know some basics of G-code, but with a good CAM software even that is not necessary. There are several versions of G-code, but all are very similar, various companies have they G-codes. For each of these codes it is required to have a post-processor or converter code. CAM software packages allow you to create the necessary "toolpath" in order to process the workpiece, based on the geometry created in CAD software. By specifying the tool path is determined which tool are we going to use and how to use it. Post-processor has an inverter (converter), which converts "tooling" commands in the G-code. While the G-code is theoretical standardized, most of the machines has its own 'dialect'. In this way, machine manufacturers protect against competition. Today CAD / CAM software packages come with post-processors, which are translated into tasks and dialects. They can be set, for any production on any machine [1], below is example of simple G-code:

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G90 G21
G00 X1.1 Y1.1 Z1.1
G01 Z-1.0 F100
G01 X2.2 Y3.3 Z-1.0 F500
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4. Furniture design

Contemporary is defined by the Oxford Dictionary as just “following the latest ideas.” That definition doesn’t adequately grasp contemporary furniture design’s essence. **Contemporary furniture** also referred to as modern furniture or modern contemporary furniture is furniture that has been built after the 19th century. The modernist art movement has heavily influenced its design. Concepts from modernist art got directly translated into the furniture world. Instead of creating furniture that was substantially visual, furniture evolved into more simplistic visual designs. The furniture, as well as the area that it resides in, are used by contemporary furniture design as part of a home’s overall design theme.

Figure 6. Example of contemporary/modern chair design

Contemporary furniture started to emerge during the 1950s. At this time New York's Museum of Modern Art made the decision to address the trend. An overall design theme is taken into account by contemporary design. It may be something that the future owner of the furniture is trying to accomplish. According to some writers, the form, texture and colors of the item should directly spring from whatever materials are used. Also, the design should combine the beauty of the materials with the utility of an object to present an item that is visually satisfying. It should be a simple design with no redundant materials and an apparent structure.

6. Conclusion

The wood industry plays a dominating role in today's wood economy. With development of technology and globalization way of living is also changed, and because of that furniture industry should be ready to response on all demands. The number of single- and two-person households has been increasing, resulting in the demand for small and portable furniture. Consumers have also been looking for furniture that is multi-purpose, foldable, and technology-driven, especially when it comes to living in smaller spaces. On other hand , consumers want luxury furniture, As the economy has grown, more consumers are willing to buy luxury items for their living and work environments. In terms of location, Europe has the largest market for luxury furniture, but developing countries such as China and India are not far behind. With luxury comes the expanding trend to go green. Many vendors are developing eco-friendly furniture. This trend is driven by environmental concerns, such as the problem of deforestation. Although eco-friendly furniture is more expensive, the demand is on the rise, making it worthwhile for manufacturers and companies to offer these products. For all this wooden products it is the most importan to be quick and to satisfy costumers, the best way to achieve this is implemention of advanced technologies like CNC machines.

7. Literature

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