# A NEW STUDY REGARDING THE DIGITAL PRINTING ON WOOD MATERIALS

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RESEARCH ARTICLE

**Abstract**
*The introduction of digital printing in the production lines that produce chairs was and is a real success for the most big companies in the domain. Each of them are very interested in developing this technology. But this technology does not stop here, because the chairs also have curved elements, namely digital printing on curved surfaces, at speeds up to 70m/min. Having a very well-technological production line one can guarantee these tolerances for digital printing, and at the moment it can produces up to 4500 printed chairs weekly. This paper describes the digital printing method using CNC (Computer Numerical Control) machining manufacturing technique.*

**Keywords**: digital printing, wood materials, advanced technology, printed colors.
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## INTRODUCTION

The present project was developed to protect the environment and certain slow-growing wood materials, such as oak, but also to be able to better refine the wood. Digital printing therefore requires very advanced technology, because the printer's colors are automatically combined through the four basic colors (Black, Yellow, Magenta and Cyan), in order to illustrate any image. Recently, digital printing has gained momentum and is done on any type of surface, starting from paper, wood, etc.

The process of digital printing on wood is a very difficult one because over time the wood works both in thickness and width, but also in length, and the deposition of dust on the surface of the wood is difficult to remove. As a result of these criteria, a printer was developed that does not have to touch the printing surface, as in the case of classic printers, which touch the paper.

The printer heads developed (by Industrial Inkjet) can print on wood, from a distance between 0.3 and 5 mm with an HD resolution at speeds that can easily exceed 120m/min. This distance allows us to print on almost any type of surface, but which must have a thickness variation between 0 and 5 mm or less.

## MATERIAL AND METHOD

Digital printing using a 4+1 axis CNC is very complex, because this CNC must be calibrated to PIXEL, which is not allowed to have deviations because, if there is play or wear on these axes, the image quality will no longer be able to be provided, or the print heads may fail.

This printing system is composed of the actual 4+1 axis CNC,

- The X axis moves the print heads left-right;
- The Y axis moves the work tables forward and backward;
- The Z axis moves the print heads up and down;
- The A axis rotates the print heads;

Axis 1 (additional) keeps the secondary tank permanently at the same distance, while axis A rotates, otherwise the ink hoses could be strangled, or air could infiltrate the installation. The print heads are electronically driven by 1024X4 lines of nozzles for each base color. The four lines (Figure 1)provide the gray level of each color, to best illustrate the image, and the printer has a total of 16384 nozzles.

Figure 1. **Four nozzles lines**

These print heads can only be touched with special wipes, which do not have lint, including skin grease, or dust particles that can damage them. If they become clogged, these heads are very difficult to clean and require quite a lot of time, especially since these heads are encapsulated.

The connection between the print heads and the image is made by the software owned (by Industrial Inkjet), namely the GIS server, which converts the image into electrical impulses and which coordinates the entire printing system such as:

- Vacuum systems that keep the ink from coming out of the heads and that pull back excess ink.
- The ink temperature that must be constantly maintained at 50 degrees Celsius.
- Resolution systems and printing speed.
- The system that coordinates the ink supply.
- The system for checking the voltage in the print heads.
- The automation and numbering system of barcodes.
- The image calibration system, which is made in the standard CMYB format.
- The system that monitors the volume of grain in the tank and the values from the vacuum pump.

In any movement there is an acceleration and a deceleration, and in this case it must be treated very precisely so as not to distort the image. The synchronization accuracy from the encoders of the CNC tables and the print heads is done with five decimal places, and if they do not synchronize, the machine stops immediately.

The calculation formulas for printing are very well calculated and constantly checked with the help of control drivers, because there is always an acceleration and deceleration, respectively an image compensation.

The dimensions of the CNC tables are 1200mm/2000mm, and physically on these distances 70m/minute is obtained on a very small distance, and for this reason the values on the table encoders are constantly synchronized perfectly with the image, otherwise a deformed image will be obtained. The maximum size of a printed piece can be 3000mm/2000 mm, and an image for this format has an average size of between 5-8 GB.

## RESULTS AND DISCUSSIONS

To print the highest quality images, the image needs to be in TIF format, in order to be able to calibrate on each standard color level.

The ink used to print on wood is a water-based UV ink, which is aligned with all environmental standards, both chemically and physically. Working with UV ink, we will also need very fast UV lamps, in order to be able to gel or dry the ink.

The amount of ink is directly proportional to the density of the image, for example if we want to print barcodes we will use a lower density, which will use approximately 1gr of ink per square meter, at a speed of 140 m/min, and if we want to print a landscape at a high density to cover the natural colors of the wood we will

use 12-20 g of ink per square meter and a speed of 10 m/min.

In wood printing production, image calibration can be done in two ways:

1. using high-speed and high-resolution video cameras, which measure and calibrate the image according to the color of the wood, but which is very expensive, since a high-performance computer is also required, which can perform these operations at speeds of 70m/minute, taking into account that we have 5-6 GB images.

2. visual calibration of the image by modifying the color curves, which is not so expensive and can be done between 3-8 hours, but which will not be able to calibrate the color for each piece of wood.

In series production, images photographed using high-resolution photospectrometers are used, which extract up to 12 image layers from real official color samples of wood essences.

Currently, around 15,000 marks are printed every 8 hours, of which over 80% are dried immediately on the machines, and the rest are dried later.

The print head anti-collision safety systems were developed to reduce damage to the print heads in the event of a collision with non-compliant parts. If this system detects an unevenness one step ahead of the print head, the machine's safety system is activated, which instantly stops the machine, blocking all CNC servomotors.

## CONCLUSIONS

Digital printing is currently done to protect wood species that grow very slowly and are increasingly in demand, the oak image is printed on beech wood and is very popular with customers because it is very affordable and the color is very close to reality. In conclusion, we can say that environmental protection can also start with digital printing on wood materials. We present below some samples for different printed colours (Fig.2, Fig.3, Fig.4).

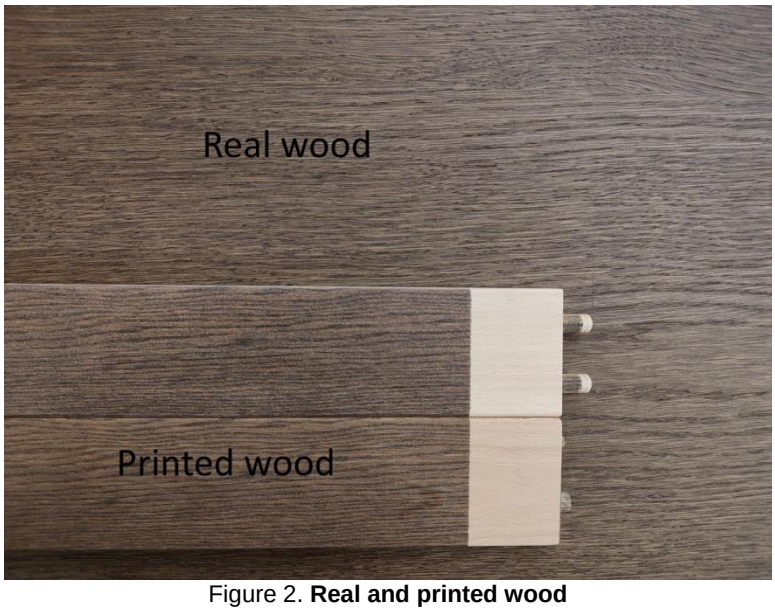


Figure 2. **Real and printed wood**

Figure 3. **Real and printed wood for the same colour**

Figure 4. **Printed oak wood**

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