

INTRODUCTION – CARVEWRIGHT CNC SYSTEM

WHAT IS CNC?

CNC (Computer Numerical Control) is a computer control process used to direct precise movements of robotic cutting, carving, and milling tools. It was most commonly found in industrial manufacturing settings, but as the technology has advanced, it is finding its way into everyday life. It is how nearly everything is made today. The CarveWright CNC is a “Personal CNC” or “Desktop CNC” system, referring to its small footprint and ease-of-use.

There are many different kinds of CNC Systems for doing various functions, but there is a common vocabulary that helps us identify and understand their basic operation.

HARDWARE TERMS



FIGURE I.1 STEPPER MOTOR

Axis - Axis refers to a direction of movement. In a 3 axis machine, the machine’s cutting capability will be in 3 directions; X,Y, & Z, or forward and back, left and right, & up and down. It is possible for more or less axis depending on the function of the machine. *The CarveWright is a 3 axis machine.*

Stepper Motors - A stepper motor (figure I.1) is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (open-loop control), as long as the motor is carefully sized to the application. Stepper motors are commonly used for lower-end CNC systems, as they lack the feedback for increased speed, power and accuracy of servo motors.



FIGURE I.2 SERVO
MOTOR

Servo Motors - A servo motor (figure I.2) is a brushed motor that uses a built-in encoder for error-sensing feedback (closed loop control) to correct the performance of a machine. This means that the system can sense the exact position of the motor, and make corrections, if the motor ever gets out of position. This is an advantage over stepper motors, as steppers have no feedback to inform the system when they get out of position. *The CarveWright is a full servo motor system.*

Gantry - A gantry (figure I.3) is a frame structure that spans an area and moves along tracks. A carriage is mounted to the structure that can move along the spanning bridge. Many CNC machines use a gantry structure for their 3 axis control. The movement of the gantry structure is the X axis, and the carriage is the Y axis. The Z axis refers to the up and down movement of the carriage.

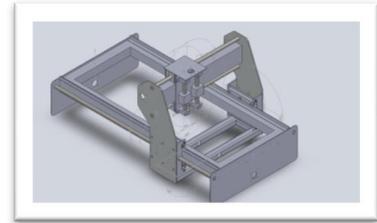


FIGURE I.3 GANTRY FRAME

Gantry systems are limited to the working area within its tracks. This means the pieces being made with a gantry CNC are limited to the size of the machine itself. Small machines can only make small parts.

Feed-Through - A feed-through is a machine that allows material to be feed through it at a controlled rate. This is commonly seen in printers as they feed paper through the machine along its X axis. Feed through systems are not limited by their footprint for the size of pieces they can make. A small machine can feed through long material. *The CarveWright uses a feed-through system for large project capacity even with it's small footprint.*

Spindle - The spindle on a CNC refers to the spinning cutting head where the bits (tools) are attached. The spindle is often the entire motor that drives the cutter, but in some cases can be driven by a motor located elsewhere in the machine. On low-end CNC machines, the spindle motor will often be a small off the shelf router that is mounted with brackets. *The CarveWright (figure I.4) uses a cut motor that drives a spinning flexible shaft to drive the spindle.*

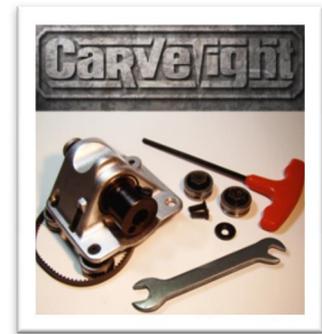


FIGURE I.4 CARVETIGHT

Controller - The controller is the brain of any CNC. It's a computer that processes the machine code commands into the actual motion the machine performs. Controllers can range greatly in size and capability depending on the machine and application. *The CarveWright uses the ServoSmart controller, which was designed specifically for it.*

Raster Cutting Operation (figure I.6) - In computer graphics, a raster graphics image, also known as “bitmap”, is a dot matrix data structure representing a generally rectangular grid of pixels. Each pixel is a tiny square that represents a color. The combination of all of these tiny squares creates an image. A raster operation in CNC works much like a inkjet printer except each pixel has an assigned depth rather than a color. It works from one end of the graphic and moves along one line of pixels before moving to the next line of pixels. The Z axis changes its depth to match the depth information for each pixel, resulting in a 3D carving.



FIGURE I.6 RASTER CARVING LINE BY LINE

Vector Cutting Operation (figure I.7) - Vector graphics is the use of geometrical primitives such as points, lines, curves, and shapes or polygons—all of which are based on mathematical expressions—to represent images in computer graphics. These graphics are infinitely scalable, since they contain no pixel information. In CNC, a vector operation means the cutter can move along the path and trace along the line or curve. This type of operation can be very fast for operations like text, cutouts, and v-carving.

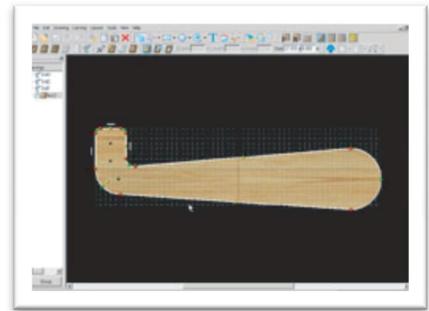


FIGURE I.7 VECTORS ROUT ALONG A PATH

OVERVIEW OF THE CARVEWRIGHT MACHINE

CARVEWRIGHT CNC MACHINE

You can think of the CarveWright CNC machine (figure I.8) as a subtractive 3D printer. It removes material, through cutting or carving, with a spinning bit, from a block of material set into the machine.

The CarveWright CNC System is unlike most CNC's in several ways. For one, the footprint of the machine is much smaller at only 15x18x26, but packs a lot of power for its compact size. The servo motors are a lot faster than the stepper



FIGURE I.8 CARVEWRIGHT CNC MACHINE

motors used on most CNC's. Unlike a gantry CNC, which is limited on project size by its bed, the CW uses a feed-through, belt drive system to feed material of virtually unlimited length. The controller is built into the machine and projects are uploaded to memory cards for transfer. Then the keypad and LCD panel located on the side of the CW allows the user to not only access their projects, but also many other built-in functions.

PROJECT DESIGNER SOFTWARE

The Project Designer software (figure I.9), is available for PC or MAC, allows several options for creation of 3D designs. A library of elements (or patterns) is included with the software. These can easily be placed on the 3 dimensional virtual board in a drag and drop fashion and then manipulated in a variety of manners including resizing, rotating, inverting, grouping and mirroring to create one-of-a kind designs. Built in drawing tools allow for creation of designs along with various other tools for the addition of text, texture backgrounds, contoured regions, lines, curves and shapes. Other options include the ability to import images, purchasing additional patterns from the Pattern Depot, and purchasing add-on modules to further expand the software's features.

There are two versions of Project Designer available:

Project Designer BASIC is a free version that is packaged with every machine.

Project Designer PRO is an upgrade version that has many more features and updates.



FIGURE I.9 PROJECT DESIGNER
SOFTWARE

Additionally, there are many add-on modules that expand the capabilities of the software.



The CarveWright System is designed to be modular, meaning you can buy only the features you want, and customize your software to your needs. This allows you control over your software and your budget.

**ADD-ON
SOFTWARE
MODULES**

Centerline Text (figure I.10) adds an additional Rout Mode in the Text Tool feature. This feature uses the 60° and 90° V-groove bits to follow the center of the letters for a clean engraved, v-cut look. The depth of the centerline is determined by the width of the text selected.



FIGURE I.10 CENTERLINE TEXT

Conforming Vectors (figure I.11) enables v-bit routing along a carved surface. Without Conforming Vectors, these types of routs can only be made on the flat, top surface of the board. The “conform” feature can be applied to any vector function, including Centerline Text and Vector Groups.



FIGURE I.11 CONFORMING VECTORS

2D Vector Drawing Suite (2D Advanced) (figure I.12) is a tool bar add-on for Project Designer that expands the drawing and vector manipulation capabilities of the software. Define vector paths quickly, trace images, trim and merge vectors together, and many other features that assist in creating your own drawings.

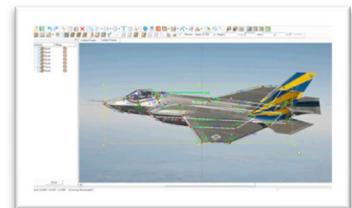


FIGURE I.12 VECTOR DRAWING SUITE

3D Pattern Modeling Suite (3D Advanced) (figure I.13) is a tool bar add-on for Project Designer that enables modeling of 3D relief patterns. Extrude, sweep, and puff shapes into dimensional creations. These tools are easy-to-use and make your own custom pattern design fun and simple.

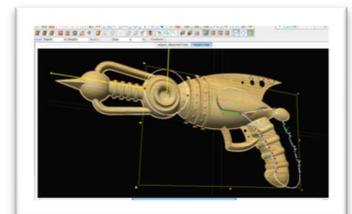


FIGURE I.13 PATTERN MODELING SUITE

The DXF Importer (figure I.14) allows the user to import 2D vector files created in 3rd Party software packages. DXF is a common format for vector software such as AutoCad, Illustrator, CorelDraw, and more. The DXF Importer tools allow for scaling, rearranging, flipping, rotating, auto-connecting of lines, splitting (tiling designs), create boards to layout shapes, and ultimately, importing those boards into Designer to be carved or cut out.

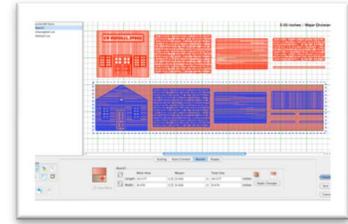


FIGURE I.14 DXF IMPORTER

The STL Importer (figure I.15) enables importing of 3D STL files and preparing them for carving. This is done by scaling the model to the desired output size, and then slicing, or cutting, it into pieces that can be carved on a flat board by the machine. The cut angles and depths can be customized to give the best possible strategy for retaining the details of the model. These slices, once carved, can then be reassembled into a physical 3D model.

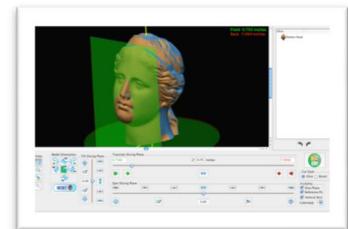


FIGURE I.15 STL IMPORTER

Pattern Sculptor (figure I.16) is a creative sculpting and editing tool for 3D relief carving patterns. Quickly and intuitively smooth, smudge, and add or remove details to prepare patterns for relief carving. This software only works with Project Designer PRO.

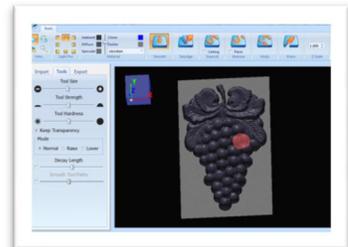


FIGURE I.16 PATTERN SCULPTOR

Pattern Editor (figure I.17) is supplied FREE with the CarveWright **Scanning Probe**. Its primary purpose is to provide tools for cleaning up and preparing scans for carving. Once finished, the patterns can be saved directly to Project Designer's pattern library for immediate integration into your designs for carving.

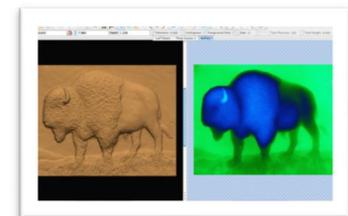


FIGURE I.17 PATTERN EDITOR

Keyhole Function (figure I.18) enables plunge cutting keyhole shaped mounting slots in items such as picture frames and plaques. It's a quick and easy way to automate making these hanging slots, so your work can be displayed. With Designer's ability to design on the front and back of your boards, adding these professional looking hanging slots becomes simple. The keyhole bit required for this is included with this module.

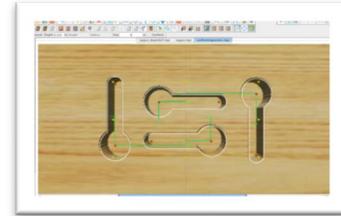


FIGURE I.18 KEYHOLE FUNCTION

ACCESSORIES

Scanning Probe (figure I.19) can also be purchased as an accessory to the CarveWright. This probe attaches like a bit on the CW machine and allows for the reproduction of 3-dimensional objects by probing the object with an accuracy of up to .005 of an inch. The resulting 3D data can then be downloaded and accessed from the included Pattern Editor software for further manipulation and use by the user.



FIGURE I.19 SCANNING PROBE



FIGURE I.20 ROTARY JIG

Rotary Jig (figure I.20) and accompanying software, enables the design, import, and carving of turned projects. It's like a lathe, but with carvings. The rotary software, included with purchase of the jig, shows the carved round piece alongside a flat board where the design is manipulated. The jig is simple to use. Load your material, calibrate the jig, and carve your pieces in the round. With the STL Importer add on, you can even import STL's directly into the rotary format.

Sanding Mops (figure I.21) are a great way to speed up and simplify the sanding and cleaning of your carvings. Attach it to a drill press or another high speed motor, and quickly polish your projects without removing your carved details. It will literally save you hours of tedious, hand sanding work. With two grits and two sizes, no matter the project, we've got you covered. We also have sandpaper refills for when you wear them out from all the great projects you are making.



FIGURE I.21 SANDING MOPS



FIGURE I.22 MEMORY CARD

Memory Card & Programmer (figures I.22 & I.23) are used to easily transfer of your project, from the Project Designer software, to the CW machine. The memory card programmer attaches to a USB port and the project is uploaded to the memory card. During this upload process, a time estimate calculation is displayed for the amount of time to project will take. There are also quality settings for changing the speed of the project. The higher you set the quality level, the slower the machine carves. The memory card allows the design work to be accomplished from your office or computer room away from any sawdust or other possible hazards in your workshop.



FIGURE I.23 PROGRAMMER

The card is inserted into the memory card slot on the side of your CW machine, and the project is selected from the on board keypad and LCD. The capacity of the memory card is large enough to hold a significant number of projects and scans. How many it will hold depends on the size of the individual projects. If the card fills up, simply delete some of the files using the Flash Manager in the software. As long as you save the project file to your computer hard drive before compiling, it can be put onto the memory card over and over. Compiled project files cannot be transferred from the card back to the software.

Third Party Accessories (figure I.24) developers are becoming more and more a part of the CarveWright family. Many of these products are great additions to your CarveWright machine and are produced by customers easier and less expensive than we could.



FIGURE I.24 THIRD PARTY ACCESSORIES

CarveWright Bits include a variety of bits for different carving and cutting purposes. The CW carving & cutting bits are all high quality carbide designed for longer-life and more precise cutting performance.



FIGURE I.25 CARVEWRIGHT BITS

There are three categories of bits (figure I.25) used with the system:

Carving Bits are solid carbide ball nosed bits. Carving bits are used for doing detailed “raster” carving and shaping. There are several sizes available for various types of carving.

Cutting Bits are solid carbide straight end-mill bits. Cutting bits are used mostly for doing vector cutout functions. The bit will follow a path, or line, designated in the software to cut an object out, drill holes, or route lines into the material.

Decorative Bits are a variety of “router” bits with several profiles to choose from. They are “plungeable” and specifically calibrated with the Project Designer Software to ensure proper speed and feed settings for each bit. They are sold individually or as a set.

Carving Bit accessories, such as split collets & rubber stop collars, description and uses are also available at www.carverwright.com/bits/

Pattern Depot (figure I.26) includes thousands of patterns from which to



FIGURE I.26 PATTERN DEPOT

choose, save to your Pattern Library in your Project Designer software and then use over and over again in your projects. There are also many pre-designed projects available with all the project files and instructions needed to create them.

To see the patterns and projects available, visit <http://patterns.carverwright.com>

For more information about the complete CarveWright product line, visit www.carverwright.com

WHAT CAN THE CARVEWRIGHT CNC DO?

Now that we have some basic understanding of what the CarveWright is, let's explore what it can do. The CarveWright is a very versatile system suitable for innumerable types of projects. It is, mostly, up to the imagination of the user to determine what it makes. However, some types of projects are more common than others.



FIGURE I.27 LITHOPHANE CARVING

TYPES OF PROJECTS

Some Common Projects with the CarveWright CNC:

- Sign Making
- Furniture Design and Restoration
- Architectural Elements
- Crafts
- Home Decor
- Model Making
- Mold Making
- Musical Instruments
- Lithophanes (figure I.27)



Craft projects that wow



Sign makers rejoice



Woodworking wonders



Model making master



Manufacturing & Prototyping



3D Print your ideas

CAPACITY OF THE CW

Maximum Dimensions

- Width – 14.5"
- Depth – 5"
- Length – 12' carving
- Weight – 20 lbs
- Work pieces over 3' long will require additional support, such as out-feed rollers, at the appropriate height.

Minimum Dimensions

- Width – 1.5"
- Depth – .5"
- Length – 7"
- If any of these dimensions fall below the minimum limitations, the work piece will require a jig.

**ACCEPTABLE
MATERIALS**

Approved For Use:

- Wood
(Hard and Soft woods)
- Foams
(HDU, XPS; EPS)
- Plastics
(PVC, Polycarbonate, Corian,
Cast Acrylic)
- Machinable Wax

NOT Approved For Use:

- Glass
- Ceramics
- Stone
- Metals
- Concrete
- Soft plastics
(low melt temperature)

Quiz

1. What does CNC stand for?
2. What is the difference between a feed-through and a gantry?
3. Is the CarveWright a feed-through or a gantry?
4. Describe the two types of cutting operations.
5. What is the Scanning Probe?
6. Name the two types of CNC drive motors.
7. Which type of drive motors does the CarveWright use?
8. What is the name of the CarveWright CAD/CAM software?
9. What are the maximum board dimensions of the CarveWright System?
10. Can the CarveWright carve/cut metal?
11. Name three add-on software modules for CarveWright, and describe what they do?
12. What are the three categories of bits used with the CarveWright System?

There is certainly more to know from this section, but this should give you a good indication of what you should have learned.