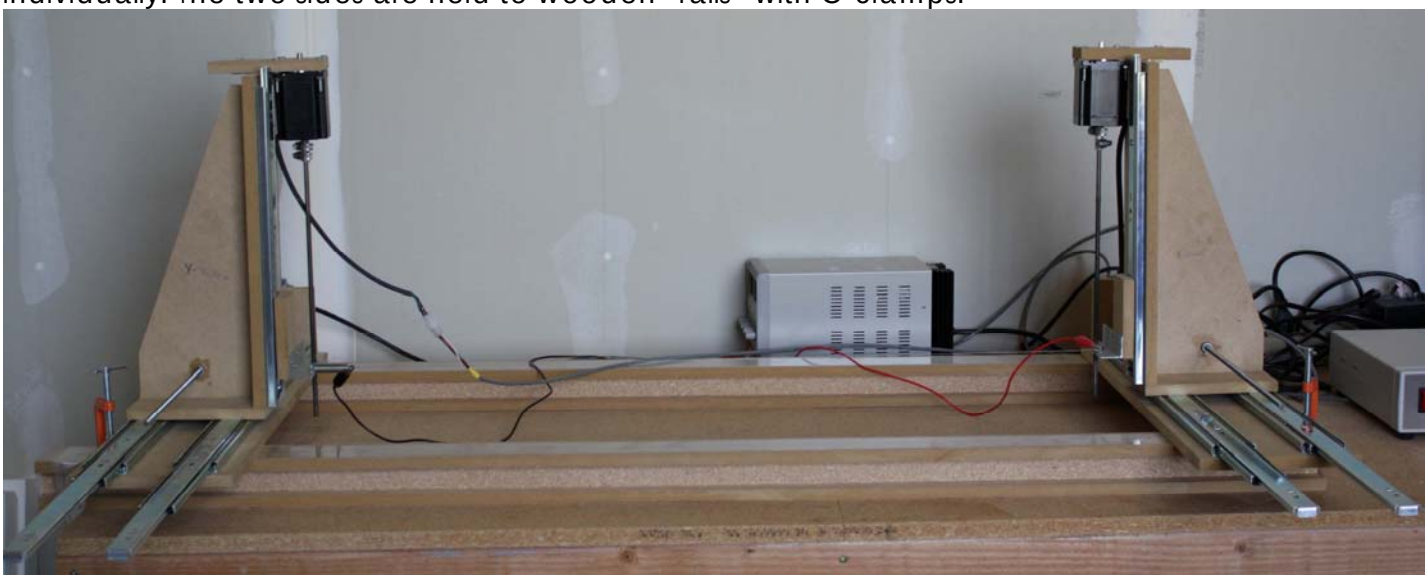
Brandon Campbell's CNC Foam Cutting Machine

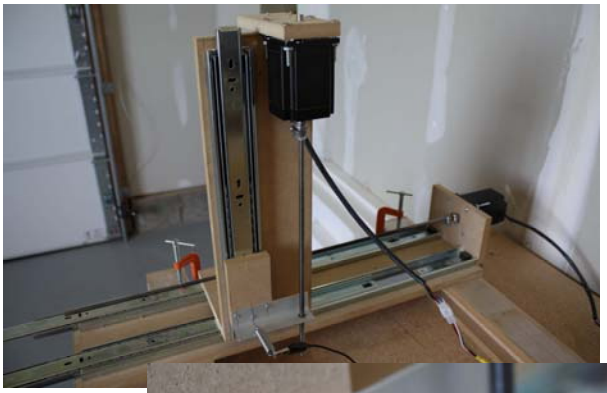
Here I'll explain the mechanical, electrical, and software aspects of my CNC foam cutting machine, in that order. If you are willing to invest a lot of time and money, then following my example will leave you with a machine that is capable of cutting a large variety of foam wing cores with excellent accuracy and quality.

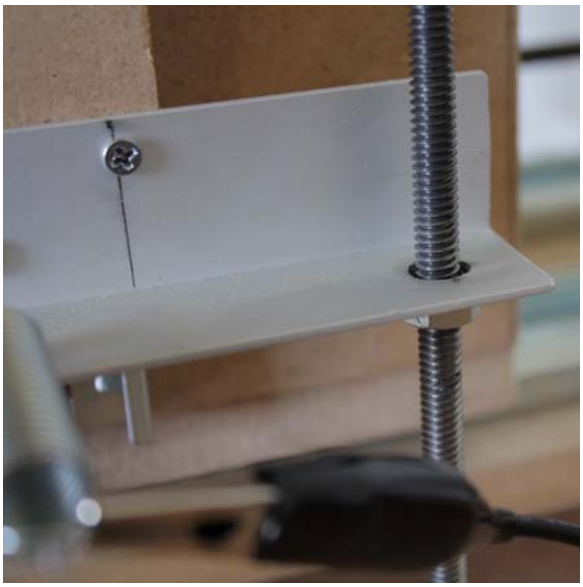
Mechanical: The concept is simple. The machine has two separate sides that are free to move individually. The two sides are held to wooden "rails" with C-clamps.



This allows me to adjust the machine to cut any size wings I want. Each side has its own horizontal and vertical axis to move on. I used full extension drawer slides to guide the motion of each axis. Each axis is moved by a length of ¼ inch 20 TPI threaded rod attached to a stepper motor, and a nut. A length of 30 gauge nichrome wire is suspended between the two sides of the machine. A spring on one side keeps the wire in tension.

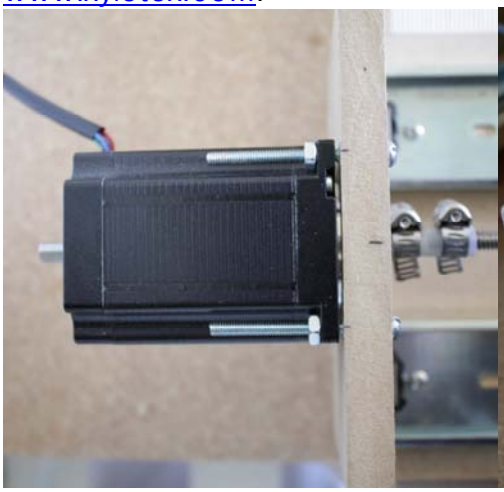
The bulk of the structure is made of ½ inch MDF. The threaded rods are coupled to the stepper motors using flexible PVC tubing and small hose clamps. This provides a coupling that can accommodate some misalignment between the rod and motor shaft. The points where the ends of the cutting wire are attached are made of aluminum "L" extrusion.



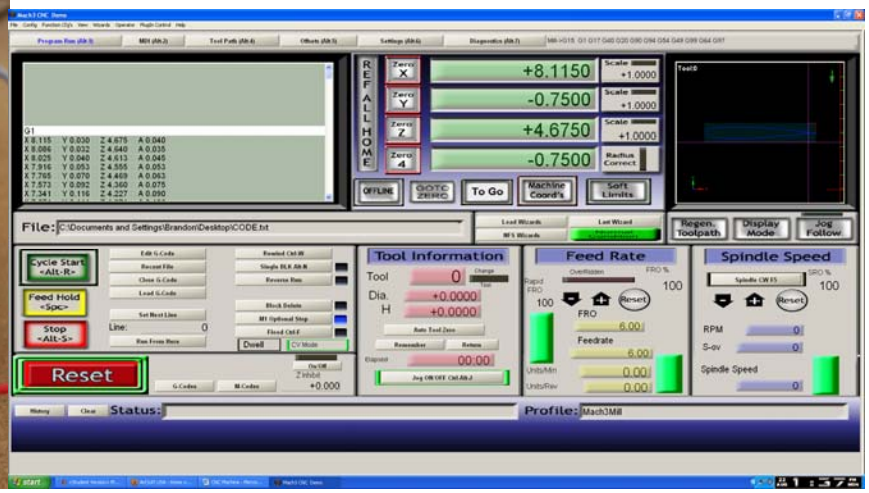


Electrical:

The machine is powered by 4 269 oz-inch stepper motors. The motors are controlled by a 4-axis drive box attached to the parallel port of my PC. Both the motors and the drive box are from www.xylotex.com.



The cutting wire is powered by a Mastech HY3003D DC power supply. This power supply is capable of outputting 30 volts and 3 amps. I like this power supply because it allows you to set the output amperage and it automatically adjusts the voltage to what you need. That means I never have to change the power supply settings no matter how long my cutting wire is, since the wire temperature will be the same as long as the current is constant. For my 30 gauge nichrome wire I set the power supply at 0.98A and cut at 8 inches per minute.



Software:

The control software I use is called Mach3. It is available at: www.machsupport.com. Mach3 interprets G-code and sends the control signals to the drive box.

I generate my G-code using software I wrote in MatLab. The software allows me to put in the root airfoil, tip airfoil, root chord, tip chord, twist, tip kerf, root kerf, sweep, and span. As will as some other parameters related to the setup of the machine. It takes this information, pulls the airfoil coordinates from a library, does a lot of math, generates the G-code, and writes it to a text file. I then open that text file in Mach3 and run it.

Tips:

1. If building a CNC machine, make your measurements and your cuts exact. Your angles need to be perfect and your machine needs to be sturdy. Otherwise it will not be capable of high

accuracy and you will get ripples, divots, excess melting spots, or other things. Don't take shortcuts or settle for less than perfect cuts – If you do you will end up spending a lot of money on a lousy machine.

2. Ideally the wire is hot just hot enough that it does not touch the foam. The foam is melted with radiant heat from the wire. Experiment a lot to get the right wire temperature and cutting speed combination that gives you a super-smooth cut with as small a kerf as possible.