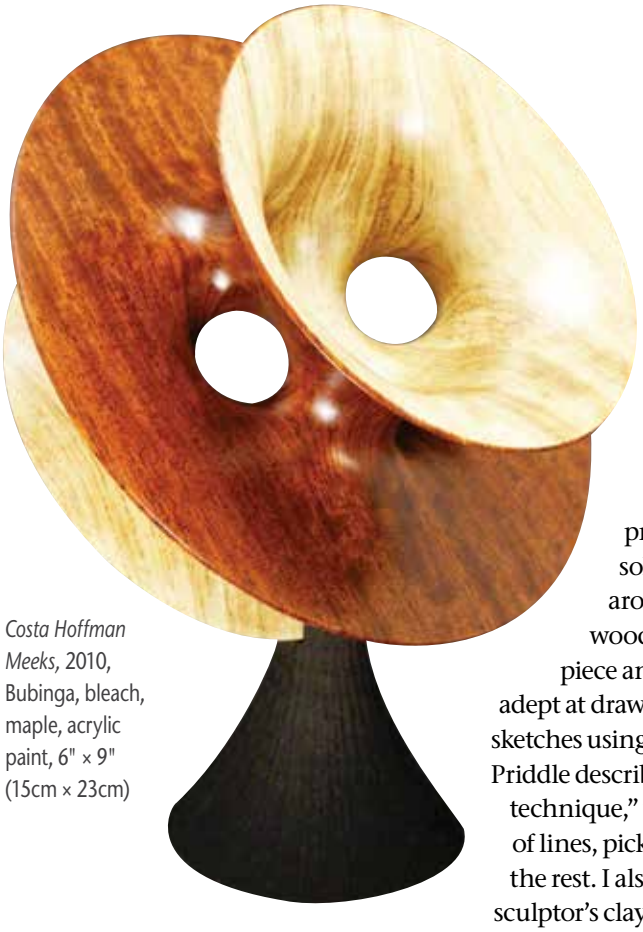
Thinking OUTSIDE the Hollow Form

Michael Foster



Costa Hoffman Meeks, 2010, Bubinga, bleach, maple, acrylic paint, 6" × 9" (15cm × 23cm)

Much of my recent work has been an exploration into a branch of mathematics known as minimal surfaces and figuring out how to express these intriguing forms in wood. I found my first references when I was researching the intersection of art and math. Minimal surfaces join curved edges in three-dimensional (3D) space in the least amount of surface area possible. Mathematicians describe these forms with math and generate 3D images using computers. I do not profess to understand the math, but I found programs that allow me to manipulate the parameters and view the results in 3D. I simply had to attempt rendering them in wood.

None of these forms fit into what we classically consider work off the lathe—bowls, spindles, hollow forms—but the lathe is capable of much more, given some thought, play, and experimenting. I often brew on a form for months, trying to imagine how I might be able to turn it on the lathe, anticipating problems that need to be solved. Sometimes I design around a particular piece of wood; other times I design a piece and find the wood. I am not adept at drawing, so I start with crude sketches using the method Graeme Priddle describes as "the many lines technique," which means drawing a lot of lines, picking the best, and erasing the rest. I also use a material similar to sculptor's clay to form a maquette.

With an idea well formulated, I use the Layers Features in Adobe Illustrator to generate precise, to-scale drawings that will fit the wood I select. I generate side views and top views, which can be right on top of each other, and then each layer turned on or off, to avoid confusion. I import files from other programs, such as minimal-surface math programs, to serve as guides for laying out curves. The screenshots of *Distortion* illustrate how I planned the turning before going to the lathe.

Safety

Part of the process requires thinking about how to do things safely. Some of my jigs may look a bit wonky, but I use a lot of screws and hot melt glue to the point I feel confident in their ability to hold the wood securely onto the lathe. I also make use of counterbalances, which are essential to keeping the lathe from bucking and vibrating. I adjust the weights as I remove wood to keep things running true. My lathe is not bolted to the floor, nor have I added weight. I turn at a slower speed than many other turners, but with work like this, I am in no hurry and would rather keep things safe—and I stand out of the line of fire.

To the lathe

There are no cookbook recipes for turning these forms. Each piece requires a different approach—unique shapes require unique ways of turning. To achieve the final form, I think of the lathe as one of many tools available for carving wood. The final form becomes the driver, and I do what is needed to get there.

Figuring out how to mount and turn a chunk of wood is as much of a challenge as the turning itself. I enjoy imagining and planning, and am surprised at my success rate. Yes, I have had failures, but not many. I started with the same skills most turners have and even now, I consider myself just a little above average. With bit of thought, imagination, and the willingness to step out of your comfort zone, amazing forms are possible. Give it a try, but think through the process ahead of time and be safe.

Michael Foster practices dentistry full time. He initially learned basic skills using a friend's shop, and then started turning on a Shopsmith, his first woodworking machine. Slowly acquiring skills by trial and error, he moved on to a Woodfast lathe. He now turns on a Robust American Beauty. Throughout the years, Mike's focus shifted from segmented work to interpretations of math and science forms.

Infinite Loop

I found a program that would use a line that forms a 3D knot and joins this line in such a way as to form a minimal surface. I liked the form that resulted from a trefoil knot (three lobes to the knot). The trefoil can be twisted and represented in several ways. I chose the middle figure in the drawing. Translating this idea to turning required a lot of thinking, but finally decided I could indeed turn much of the form. The holes through the knot are not perpendicular to the face, so I had to figure out how to mount the form to be able to turn them. I could have done something similar using jigs and a drill press, but I am a turner.

Infinite Loop, 2011, Elder burl, epoxy, 8½" × 5½" × 2" (22cm × 14cm × 5cm)

Lawson

While perusing minimal surfaces online, I found a class of surfaces that were enclosed forms. The mathematicians who described these got inspired looking at microscopic images of protozoa and bacteria. Some of these organisms had tunnels through the body and the resulting outside of the form is a minimal surface. I knew instantly I could turn this almost entirely on the lathe. This one was really fun because it required several different lathe techniques: hollowing, multiaxis, and spindle. ▸

Lawson, 2011, Butternut, dye, 8½" × 5" × 5" (22cm × 13cm × 13cm)

Trefoil

Using one of the minimal surface programs, I designed what is known as a polar-Enneper form with three lobes. I imported the result from the minimal surface program into Illustrator and realized the whole form starts with an ellipse, and each of the lobes could be turned as well. I had to do some careful layout on the ellipse after turning it.

I had the initial idea to turn the elliptical form between centers, but the drive center would be at too steep of an angle and would have required making flats to accept the drive into the turned area; that would ruin the surface. My solution was to devise my own drive center. I used the jig to turn all six lobes, just repositioning the blank carefully and using hot melt glue to fix it each time. I turned the hollows in the ends after turning the lobes. I included a few photos of the carving process to illustrate the division between lathe-carving and hand-carving.







Trefoil, 2012, Masur birch, maple, dye, 10" × 7" × 7" (25cm × 18cm × 18cm)

Tao of Geometry II

I envisioned a sculpture that referenced the yin-yang symbol, and ended up liking the completed form better than the 3D image. Mounting was similar to *Infinite Loop*, but I refined and beefed up the jig because the wood was larger.



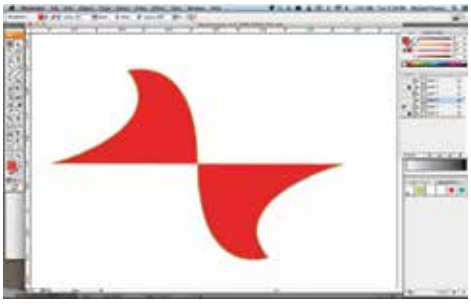

Tao of Geometry II, 2012, Elder burl, aniline dye, bleach, acrylics, Compwood, India ink, 12" × 14" × 4" (30cm × 36cm × 10cm)

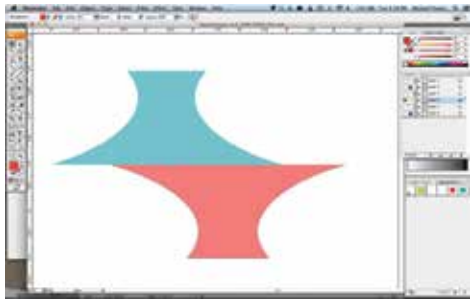
Distortion

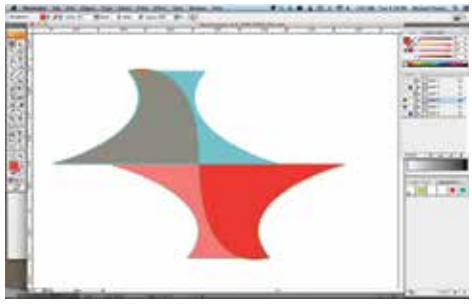
I started with the turning blank screwed onto a faceplate, making sure the screws would not penetrate through the wood into the small hollow form, which would be located on that side. I turned the form to closely match the design, and then hollowed it.

I made a jig to hold the opposite side, offset the correct distance, using my design as a guide. I fit the jamb chuck close to the wide portion at the top. Using the tailstock for stability, I turned away most of the wood. Hot melt glue held the work to the jamb chuck while I hollowed that side. This piece was not so off-balance to require adding counterweight. To achieve the final form, I carved the wood. ▶

Distortion, 2012, Maple burl, mopane, 5" × 8" × 10" (13cm × 20cm × 25cm)



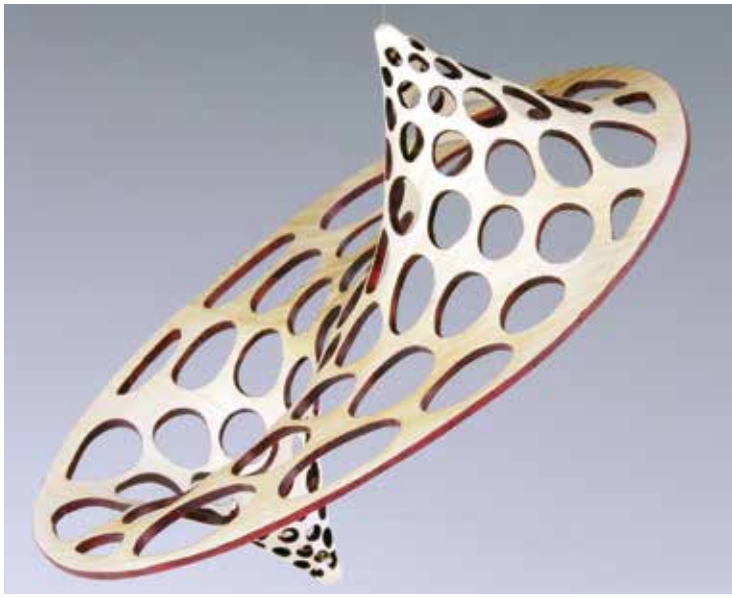




Conic Inversion

Conic Inversion is a form that joins a pair of inverted cones and a flat plane that bisects the two in a minimal surface. I was pretty sure there was a way I could turn the form on the lathe, but I had to think about it for quite a while before coming up with the solution. I started by turning the blank between centers, forming a small tenon in the center that would become the outer edge of the form, but more importantly allowing me to hold the blank after reversing the form. I turned off waste from one end until I reached the diameter that would be the horizontal separation of two turned cones. This lightened the blank for the next step.

Conic Inversion, 2012, Ash, bleach, acrylics, 5" × 7" (13cm × 18cm)



I used the live center to hold the work against a piece of MDF mounted onto a faceplate to mark where the blank should be mounted. I found the center of the outside and drilled a hole in the MDF that would accept a small tenon left on the headstock end. The small tenon fits close to the hole and orients the blank for turning one cone and hollowing the other. I screwed the blank to the MDF, taking care not to put screws into areas that would become the final form. With the tailstock in place for support, I turned the cone.

I rotated the blank 180 degrees and screwed it in place again to turn the recess of the opposite cone. After removing the form, I turned a hole in the MDF to allow the cone to protrude through it. I also turned a small recess, carefully fitting it to the tenon in the blank I first turned. This allowed me to mount the form using many screws with washers that captured the tenon. I could then remove the mass of waste left and form the opposite cone.

When turning the first cone, I formed a dovetail just large enough to hold it in a dovetail chuck to hollow the last recess and complete the turning. I could not have completed this turning without thinking through all the steps, planning how to mount and turn each step. It is a thrill when the steps easily flow from one to the next, using the lathe in unconventional ways. ■