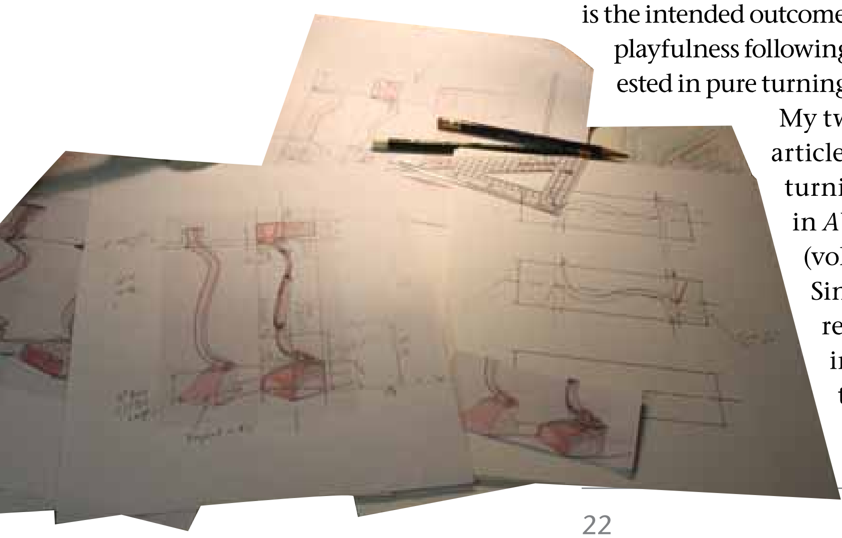
Multiaxis Spindle Turning: Further Exploration

Barbara Dill

Born into poverty in 1900, Louis Armstrong learned to play the cornet while in reform school. A few years later he was given his first cornet and mentored by King Oliver and others to play jazz by ear. The rest is history.

Some artists are like Louis. This article on multiaxis turning is for the rest of us.

Admittedly, multiaxis turning is complex. Even so, some turners can create forms randomly and get great results. Most of us, however, need a more structured approach so we can first experiment with confidence and then branch out in our own direction.



This article offers an updated conceptual model designed to systematically present the essential elements found in multiaxis spindle turning. An orderly exploration is the intended outcome, with creative playfulness following for those interested in pure turning pleasure.

My two previous articles on multiaxis turning appeared in *AW* in 2007 (vol 22, nos 3, 4). Since then, I have refined my thinking, explored the application of multiaxis spindles for a variety of projects, and combined the multiaxis concept with split and inside-out turnings to create a new body of work. Jazz is happening.

Significance of a conceptual model

Exploration with a structure

Changing the axis provides woodturners with unlimited forms, within the limits of the lathe and the wood. In music, the notes must be studied, the limits of the instrument understood, and the musician must have the skills to produce music. Theory, technique, and skill come first; improvisation (jazz) comes later. So it is with multiaxis woodturning. A conceptual model provides structure and offers options that one might never realize if the axes were randomly changed and cuts arbitrarily made.

Repeatability

Turning on one central axis is straightforward and predictable. When many axes are used, forms are randomly created by luck and experimentation, and at times there seems to be nowhere to go. A conceptual model provides a systematic way to intentionally explore and repeat the forms that are possible.

Teaching concepts

Rather than giving a blueprint for what I make, this article provides the building blocks needed for a conceptual understanding of multiaxis turning. With this knowledge, you can experiment and combine forms to come up with new designs of your own creation.

Creativity

We are creative when we think for ourselves rather than copying ideas from others. The conceptual model helps woodturners learn the basic techniques of multiaxis turning, which then allows for confident, creative self-expression using multiaxis techniques.

The conceptual model

One central axis

When a spindle is turned on one central axis, the result (outcome) is always circular or cylindrical. The *profile* can vary, within the limits of *the length and diameter of the wood.* The elements for creating a variety of profiles are beads, coves, V cuts, and straight lines *(Photo 1).* ▸

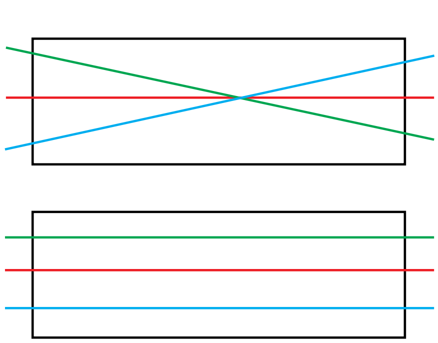


Figure 1. There are only two ways a new axis can be placed in relation to the center axis: parallel or intersecting. When a new axis intersects the center axis, the outcome looks twisted.

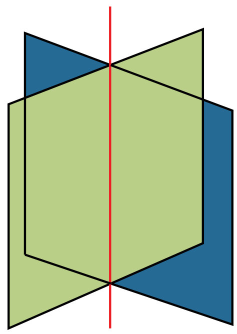


Figure 2. These planes intersect the center axis. The diagram can help with visualizing placement of the new axes in relation to the center axis and to each other.

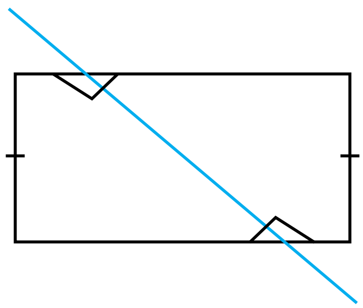


Figure 3. This axis is placed at an extreme angle to the center axis, one of thousands of ways to place a new axis.

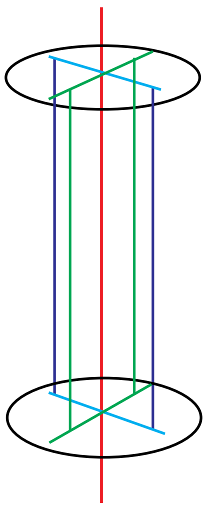


Figure 4. The four new axes are parallel to the center axis (red). The green axes are in the same plane with each other, as are the blue axes. Each plane is 90° to each other.

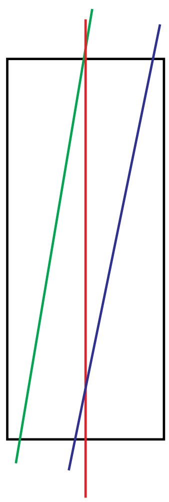


Figure 5. These axes are parallel with each other while intersecting the center axis.

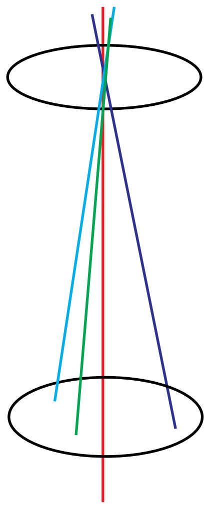


Figure 6a. The three new axes have been moved only on one end and they are twisted axes, meaning that they intersect the center axis (red) at some point.

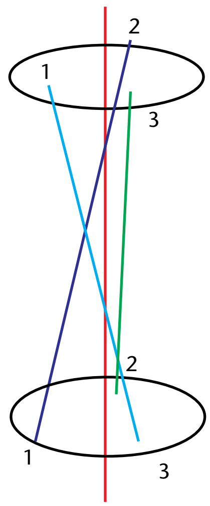


Figure 6b. The illustration shows the axes' connections at each end: axis 1 on the bottom is connected to axis 2 on the top, axis 3 on the bottom is connected to axis 1 on the top, and so on. The outcome will be twisted. Keeping the numbering consistent is essential to help systematically create (or re-create) multiaxis designs.

This spindle was turned with one central axis. The profile consists of beads, coves, and V cuts.

This multiaxis spindle is a circular-type multiaxis spindle. There are three axes on the bottom and one center axis on the top.

This arc-type multiaxis spindle has two axes parallel to the center axis and they are in the same plane.

Multiple axes

When turning a multiaxis spindle, there are only two outcomes or results: *circular type* and *arc type*. A circular-type result occurs when the axis of rotation is moved from the center axis to a new axis and the spindle is cut deeply enough to reach solid wood and form a new cylinder on which a profile is turned *(Photo 2)*. When the spindle is cut less deeply, not reaching just solid wood (still turning air), an arc on which a profile is turned is created *(Photo 3)*. It is important to note that for any multiaxis spindle, the result will be either a circular- or arc-type profile. This is the case when using either parallel or twisted axes (more on those later).

Variables

Just as traditional spindles are created by changing the profile on one axis, multiaxis spindles are accomplished by changing the profile on multiple axes. There are only two ways these new axes can be placed relative to the center axis: parallel to the center axis or crossing (intersecting) the center axis *(Figure 1)*.

The variables used for creating multiaxis spindles include, but are not limited to: (1) the various placements of the axes, (2) the number of axes used, (3) the distance from the center axis, (4) the way the axes are combined, (5) the axis orientation used to join the spindle to separate component, (6) the symmetry or asymmetry of the profile, (7) the depth of the cuts, and (8) the size and shape of the wood.

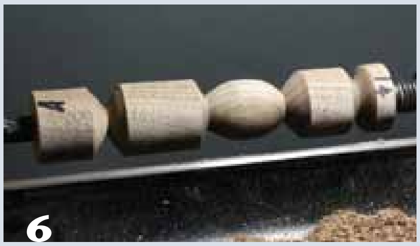
The basics of the variables

Placement of the ends

Either one or both ends of a spindle can be moved from its center point to create a different axis. That new axis can be in the same plane or in different planes *(Figure 2)*. The planes used can intersect at any angle and the axes can be placed either close or not close to the center axis.

A new axis, positioned close to the center axis, allows enough solid wood for a circular outcome, in this case, a bead.

A new axis, located close to the outside of the spindle, results in substantial air-wood. An arc-type outcome is possible.



Before the end points are changed to create a new axis, a bead and/or V cuts can be made into the cylinder using the initial central axis. Note that the entire spindle is turned to a cylinder before proceeding.

From the starting point of a bead turned on the central axis (see *Photo 6*), additional profiles are turned using other axes.

A disc shape works well as a transition form from one element to the next, one axis to the next.

Additional considerations

- The angle of an axis as it crosses the center axis can be extreme by using the sides of the wood rather than the ends *(Figure 3).*
- An axis is considered parallel when each end is moved the same distance and direction from the center axis *(Figure 4).*
- Axes can also be parallel to each other and can cross (intersect) the center axis *(Figure 5).*
- An axis is considered twisted when each end is moved in a different direction and distance from the center axis so that the new axis intersects the center axis or another axis at some point. The spindle can be repositioned on one or both ends *(Figures 6a, 6b).* The results look twisted.

Distance from the center axis

First, some terminology: I use two terms to describe the kind of wood presented to the tool in multiaxis turning. *Solid wood* is the wood that appears as a solid mass when the spindle is spinning around on the lathe. *Air-wood* is the wood that appears as a shadow as the wood rotates on the lathe. (Some turners call this wood *ghost wood.*)

The distance and direction the new axes are placed with relationship to the center axis is an important consideration inherent in multiaxis turning. When a new axis is closer to the center of the spindle, the solid wood is large *(Figure 7, Photo 4).* When the solid wood is large, a circular outcome is easier to create because (1) there is more solid wood on which a profile can be turned, (2) there is more wood available to connect the other new axes, and (3) there is less "cutting through air" to contend with.

Conversely, when a new axis is positioned close to the outside of the spindle, the air-wood is large. When the air-wood is large, an arc-type outcome is possible *(Figure 8, Photos 5a, 5b).* (A ▸

Combining the axes' segments

There are many ways to combine the various profiles that can be created by each axis of a multiaxis spindle. A sphere, large bead, or a V cut can be turned on the center axis before the end points are changed *(Photo 6).* From this starting point, a second segment, created with a different axis, can be created *(Photo 7).* A disc with either curved or straight sides, sharp or rounded edges, is a profile that works well as a transition from one axis's profile to a profile from another axis *(Photos 8, 9).* Jean-François Escoulen made popular a golf-club profile that distinctively links the segments of his multiaxis spindles *(Photo 10).*

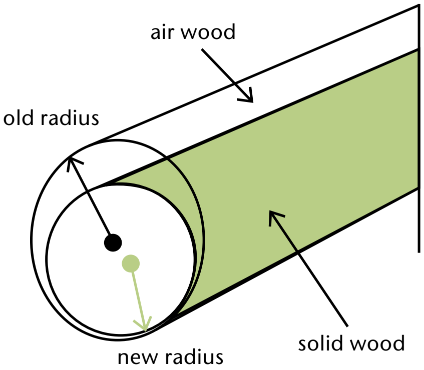


Figure 7. The new axis that creates the green solid wood is located closer to the center axis than to the edge of the cylinder. The solid wood is large, providing sufficient wood on which to turn a circular profile.

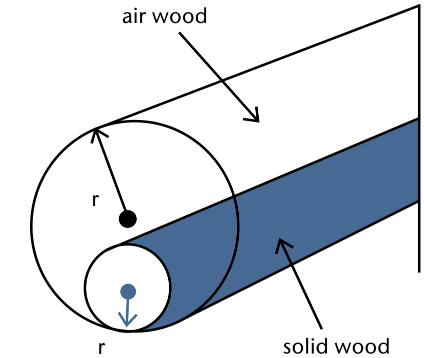
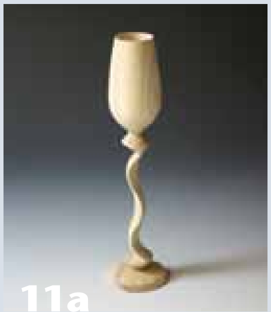


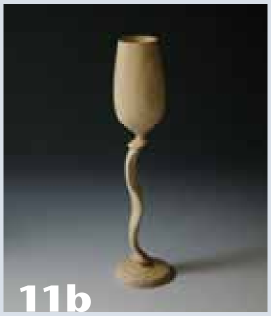
Figure 8. The new axis that creates the blue solid wood is located close to the outside of the cylinder, far from the center axis. The solid wood is small, which allows more air-wood onto which a profile can be turned, and the outcome will be an arc type. If, however, a circular profile is turned on the blue solid wood, the spindle would be thin, and it would be difficult to connect this axis to other axes that are located close to the outside of the spindle.

Two disc forms connect long beads with a sphere, joining the various elements of three axes.

John Pirson turned this spindle using a distinctive form made popular by Jean-François Escoulen.



11a The center axis of this multiaxis stem was used to line up the separate components—cup, stem, and base—of this goblet.



11b The axis used for the stem of this goblet is one that is parallel to the center axis and was also one that was used to create the stem.

12 An elegant candleholder can be created from a multiaxis spindle and base, with the addition of a separate cup on top.

13a Inside-out turnings can be safely held together with strapping tape. In addition, glue is applied at the ends. When finished, all four pieces will have been turned on four different parallel axes.

13b These spindles are the result of inside-out turning, turned on all four sides.

circular profile could be turned on the solid wood; however, the spindle would end up thin and fragile, making it difficult to connect to another element.)

Connect multiaxis spindles to a project

After a spindle has been turned, the next stage offers a multitude of design options. Any orientation of the spindle can be used (including an axis that was not used for turning) to connect a multiaxis spindle to a cup and base to create a goblet *(Photos 11a, 11b)* or candleholder. A spindle with base can be connected to a cup to end up with a candleholder *(Photo 12)*. The orientation you select can dramatically affect the look of a goblet, candleholder, or sculpture. Most of the time, however, the center axis is used to align the spindle to the components of a goblet or candleholder.

Thermed, split, and inside-out turnings

The axis is totally outside of the spindle when therming (see Art

Helpful hints for multiaxis turning between centers

- First, turn the entire length of wood to a cylinder. If the ends are not rounded into a cylinder, it is difficult to turn them later when the spindle is thin and fragile.
- Decide the type of outcome you will turn, or at least have an idea of the axes you want to play with. When the mounting points on the ends are determined, press the spindle between centers on those points so that later, when the spindle is fragile, the holes are already there.
- Number the axes not only on the ends but also on the outside of the spindle. I use a permanent marker that is dark enough to see the numbers *(Photo 14)*. Also, decide on a numbering system and stick with it. If the numbers are the same on each end and twisted axes are used, either remember the progression or write it down for reference (such as 1 to 2, 2 to 3, and so on). Even without distractions, it is easy to get confused.
- Take notes on the project so it can be recreated. I save a sample spindle with the ends intact to remind me of the process.
- Sharp tools and the speed of the lathe are important factors for making a smooth cut. The tool has more time in the air than on the wood when the speed is slow, causing the tool to bounce. To make smoother cuts, I use the fastest speed on my lathe, which is 3,000 rpm, whenever it is safe.
- When making an arc-type spindle and turning more than two axes, the depth of cut becomes critical. The toolrest can be used as a reference point for the depth of the cut.
- Sanding is a challenge because the surfaces are curved and the edges are crisp. My goal is to sand as little as possible. This means the cut must be as smooth as possible.
- Cloth-backed abrasive is thick enough to hold while sanding these surfaces. It helps to sand each axis before moving on to the next axis. The circular type can be sanded with the lathe running, but knuckles are in danger, so use caution. The arc type and any other non-round surface must be sanded by hand being careful to keep the edges crisp. I sometimes let the lathe hold the spindle while I sand it by hand.

14 *Write the axes numbers on the ends and sides of the cylinder so they are clearly visible. Even with a numbering system, though, mistakes are easy to make.*

Liestman, "Beyond Round—Therming," *AW*, vol 25, no 2). With split and inside-out turnings, the axis point is located at the extreme corner or edge of each piece of wood (see Peter Exton, "Turning Diamonds," *AW*, vol 25, no 1). For all three—thermed, split, and inside-out turnings—the outcomes are arc-type. For these methods, several pieces of wood can be safely attached together and turned, and multiple masterpieces (or multiple pieces of firewood) can be made at the same time.

The technical advantage of turning multiple spindles together is that the turning is balanced, even when turning large multiaxis spindles—the tool is cutting more solid wood than air and the cuts are smoother. There is unlimited opportunity for creative combinations of multiaxis turning to thermed, split, and inside-out turnings.

Personal expression

In my recent and ongoing explorations, I am experimenting with combining multiaxis turning with split and inside-out turnings *(Photos 13a, 13b)*. This exploration can be both frustrating and rewarding, but either way, the ideas are endless *and* the possibilities infinite. The rhythms of jazz are increasingly present in my head, appearing in my work as expressions of my own creation. There is much fun waiting others who are willing to enter into the fascinating realm of multiaxis woodturning. ■

Barbara Dill lives near Richmond, Virginia, and has been turning wood since 1990. She teaches locally and regionally. Visit her website at barbaradill.com.

Recently I have been working with flat, rectangular pieces of wood to create containers. I place the wood between centers and turn the ends, as well as the sides. I turn the wood by cutting with the grain parallel to the axis of the lathe (as in spindle turning), and then reposition the wood to turn it with the grain running perpendicular to the axis of the lathe (in the same manner that a bowl is turned). The possibilities and combinations are endless.

An exploration in multiaxis turning can combine spindle turning with faceplate turning.

Multiaxis Conceptual Model

Variables	Arc Type	Circular Type
Parallel Axis (Does not cross center axis) Other variables **Profile:** straight, curved, or V cut, symmetry, depth of cut **Axes:** number of axes used, the many options of axis placement, distance of new axis from center, various ways to connect the axes, the axes used to combine a spindle to another separate element **Wood:** size and shape of wood		
Twisted Axis (Crosses center axis) Other variables **Profile:** straight, curved, or V cut, symmetry, depth of cut **Axes:** number of axes used, the many options of axis placement, distance of new axis from center, various ways to connect the axes, the axes used to combine a spindle to another separate element **Wood:** size and shape of wood		

Multiaxis Gallery
Barbara Dill

Barbara Dill, *Three Square Forms,* 2011, Maple, 11" × 3½" × 3" (28 cm × 9 cm × 8 cm) (tallest form)

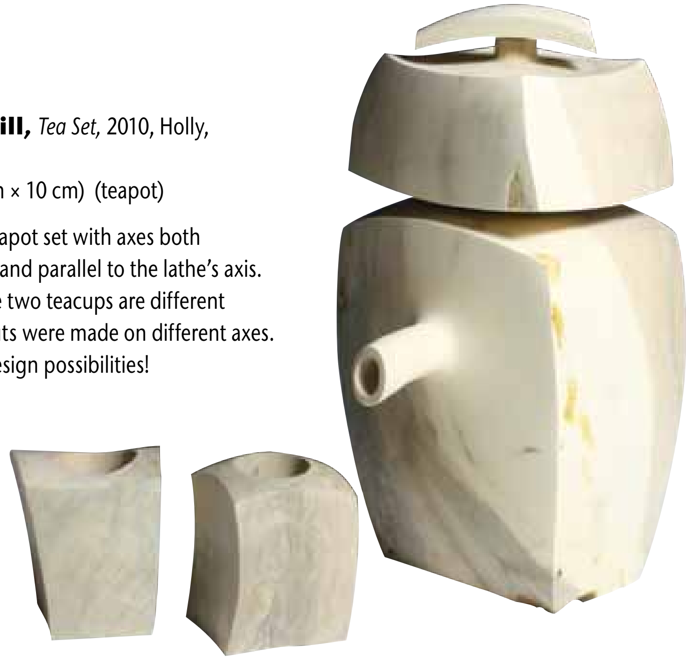
These forms are an exploration into creating various forms using the same multiaxis concepts.

Barbara Dill, *Tea Set,* 2010, Holly, 11" × 4½" × 3" (28 cm × 11 cm × 8 cm) (teapot) 3½" × 2" (9 cm × 5 cm) (cups)

I used mental images of other turned and carved wood teapots for inspiration for my early exploration of teapot sets. This is my first. My goal was to turn all pieces between the headstock and tailstock. The square surfaces are turned using axes that are perpendicular to the lathe's axis. The spout is one of the tenons used in turning. There is no carving.

Barbara Dill, Untitled, 2011, Cherry, holly, walnut, 10" × 4" × 4" (25 cm × 10 cm × 10 cm) (center form)

Michael Hosaluk's playful approach to his work is very inspiring. He simply says, "I make parts and then put them together."



Barbara Dill, *Tea Set,* 2010, Holly, 10½" × 5" × 4" (27 cm × 13 cm × 10 cm) (teapot)

I turned this teapot set with axes both perpendicular and parallel to the lathe's axis. The tops of the two teacups are different because the cuts were made on different axes. Imagine the design possibilities!

Barbara Dill, *Pitcher,* 2011, Maple, 7" × 3" × 2" (18 cm × 8 cm × 5 cm)

I turned the spout at the same time that I turned the front plane. Previously, I had carved the spout into the first pitcher I made, and then realized I could turn that detail. This approach minimizes the carving needed to finish the spout. The handle is carved and attached as a separate component.

Barbara Dill, *Sugar Bowl With Spoon,* 2010, Holly, 5" × 3½" × 3" (13 cm × 9 cm × 8 cm)

The sugar bowl is six-sided. I turned the shape of the spoon; its bowl is carved out.

Barbara Dill, *Tea Set,* 2011, Mulberry, 7" × 5" × 5" (18 cm × 13 cm × 13 cm) (teapot)

Barbara Dill, *Cookie Jar,* 2010, Holly, 7½" × 4½" (19 cm × 11 cm)

This cookie jar has six sides, each one turned.

Multiaxis *Turning* Gallery

The work of many turners has inspired my own creations. The images in this gallery represent a brief overview of their multiaxis work.
—Barbara Dill

Derek Weidman, *Zebra,* 2011, Maple, ebony, pink ivory, 8" × 6" × 9" (20 cm × 15 cm × 23 cm)

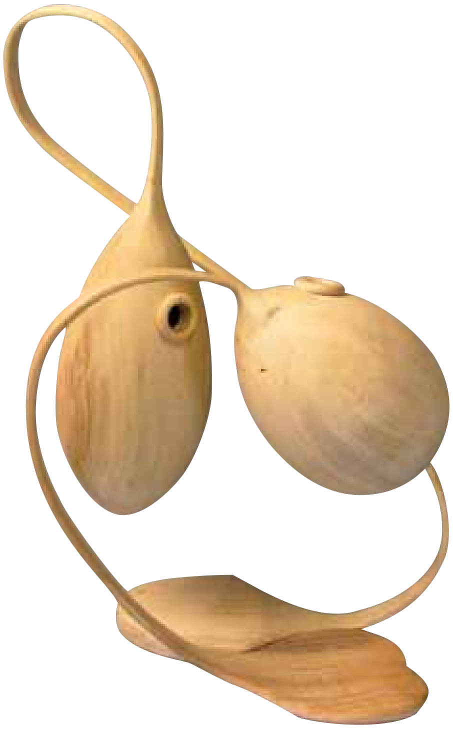
Derek Weidman, *Asterion,* 2011, Cherry, holly, 12" × 10" × 9" (30 cm × 25 cm × 23 cm)
Photo: Karl Seifert

All the pieces in my Animal Series have the geometry of the lathe at the center of their creation. I begin with an appropriate-sized piece of wood and attempt to draw the animal, using as many axes as necessary. I move the piece around freely between centers, cutting away anything that doesn't belong. When the turning is finished, the abstract qualities and novel representation of the animal are the direct result of my attempts to tease a recognizable form out of my imaginative interaction with the lathe.
—Derek Weidman

Derek Weidman, *Rhino,* 2010, Locust, ebony, 9" × 7½" × 10" (23 cm × 19 cm × 25 cm)
Photo: Karl Seifert

Tom Crabb, *Three Pods,* 2006, Plum *(left)*, poplar *(center)*, mesquite, 3½" × 5", 5½" × 8" × 4½" × 5" (9 cm × 13 cm, 14 cm × 20 cm, 11 cm × 13 cm)

The mesquite pod is turned on two axes and hollowed from the bottom.



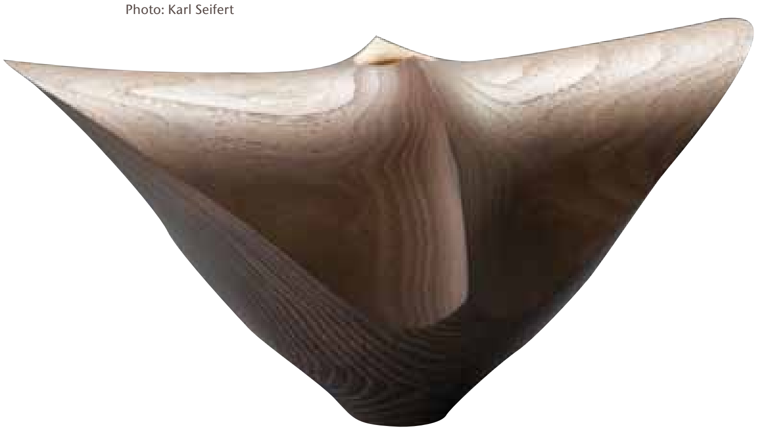
Tom Crabb, *Tango,* 2008, Hackberry, 8" × 3½" (20 cm × 9 cm)

Turned on two axes, then steam bent.

Mark Sfirri, Hall Table, 2011, Bubinga, mahogany, paint, 36⅛" × 41" × 15½" (92 cm × 104 cm × 39 cm)

Luc Deroo, *Tenue de Soirée #4,* 2010, Locust, 5" × 13" × 7" (13 cm × 33 cm × 18 cm)

Photo: Karl Seifert



Luc Deroo, *Lunar Landscape #11,* 2010, Redwood, 5" × 7" × 6" (13 cm × 17 cm × 15 cm)

Photo: Karl Seifert

Keith Holt, *Self Portrait,* 2011, Holly, 6½" × 3½" × 4" (17 cm × 9 cm × 10 cm)

I created Self Portrait using a sphere jig, and it is almost entirely shaped on the lathe.
—Keith Holt

Keith Holt, *Curious Figure,* 2011, Bradford pear, gesso, 14" × 4" × 5" (36 cm × 10 cm × 13 cm)

Curious Figure is the combination of multiaxis turning and carving, a process I am calling linear extraction.

Michael Hosaluk, *Conversation,* 2009, Maple, gesso, 10" × 12" × 5" (25 cm × 30 cm × 13 cm)

Photo: Trent Watts