



## RhinoCAM at McCafferty Dulcimers

[McCafferty Dulcimers](#) located in Brookshire, Texas has been crafting fine [Appalachian dulcimers](#) since 1993. Owner and operator [Terry McCafferty](#) grew up around woodworking with a carpenter father and worked as a cabinet maker in his early years. He was later educated as an engineer and spent four decades involved in product design & development. Terry holds several patents related to large machinery that he has developed. We recently sat down with Terry in his studio to discuss the Appalachian dulcimer craft and his use of [RhinoCAM](#) from [MecSoft Corporation](#).





## What's an Appalachian Dulcimer?

The [Appalachian Dulcimer](#) is an instrument that is typically played on your lap while sitting down. The instrument first appeared in the US in the early 19th century among Scotch-Irish immigrant communities in the [Appalachian Mountains](#) of the eastern United States. While the instrument has no known precedent in Ireland or Scotland, extensive research has traced the instrument's development through several distinct periods, and likely origins in several similar European instruments: the [Swedish hummel](#), the [Norwegian langeleik](#), the [German scheitholt](#), and the [French épinette des vosges](#) as far back as 1700 to mid 1800s.

Watch and listen to Appalachian dulcimer player Stephen Seifert putting a McCafferty Dulcimer through its paces. Beautiful Appalachian music!





## The RhinoCAM Difference

Terry's building methods are from two worlds. The traditional craft allows for personal touches, adapting to the material at hand, and evolving the art of dulcimer design. The modern world of CNC machines accommodates precision where needed and repeatable processes for predictable results. Many machining fixtures and detailed processes go into the making of each McCafferty dulcimer. *"Is there a better way"* is always running through Terry's mind as he crafts each instrument. Terry's studio is well appointed to accommodate the most effective approach for each task at hand.





*"If I have a problem and I call MecSoft for technical support, I get it ... and they fix it! There are so many companies out there today that you cannot speak to a real person. You can send them a message and maybe they'll respond but MecSoft tech support to me is second to none!"*

*Terry McCafferty, Owner/Operator  
McCafferty Dulcimers, Brookshire, TX*



[Listen to Terry](#)





## Mother-of-Pearl Inlay (2½ Axis Machining)

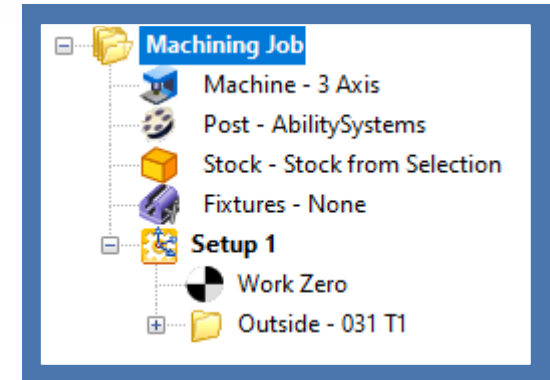
The fretboard of an Appalachian dulcimer crafted by [McCafferty Dulcimers](#) can include from up to [25 different standard patterns and growing](#), and also have the option for custom patterns as requested. In the following sections we discuss how Terry approaches the machining of the mother-of-pearl inlays as well as the inlay pocketing. **Two of Terry's beautiful inlay examples are shown below.**



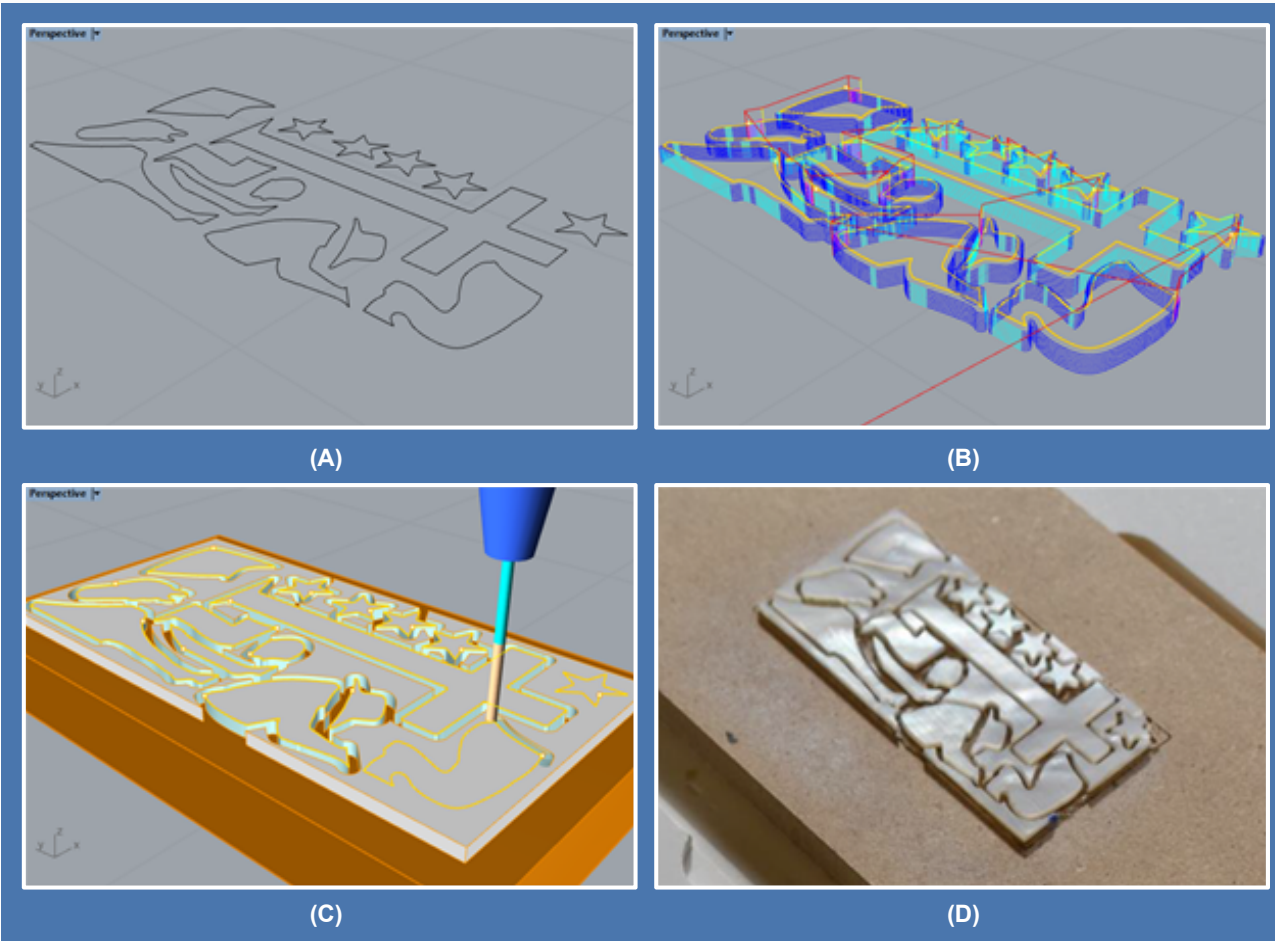


## Cutting the Mother-of-Pearl

The mother-of-pearl stock material is 1" wide by 2" long and 0.046 thick. It is mounted onto an MDF base using soluble adhesive. The control geometry are 2D planar curves representing the outside perimeter of the inlays and are positioned on the top of the inlay stock. Terry uses one 2½ Axis Profiling operation at a cut depth of 0.064" to cut all off the inlays from each stock sheet. The Machining Job tree is shown here. Once machining is complete the adhesive is dissolved and the inlays are ready to mount. Details about the machining process are provided for each image description below.



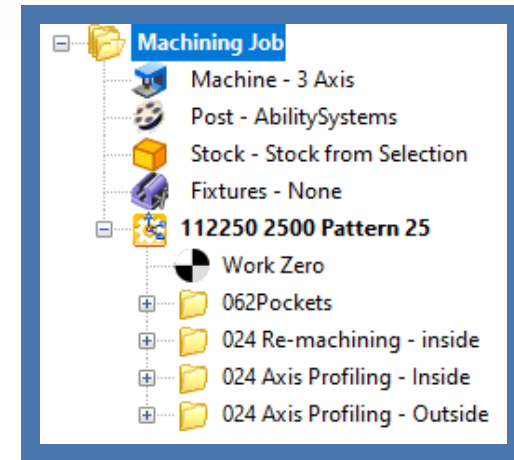
- A. This project starts with planar 2D curves drawn in Rhino that represent the 0.043" thick mother-of-pearl stock. Image (A) shows the outline curves nested into a mother-of-pearl stock sheet.
- B. This image shows the 2½ Axis Profiling toolpath using a 0.03125" dia flat end mill at a General Tolerance of 0.0001". The Cut Feed (Cf) is set to 9 in/min. The total cut depth is set to 0.064" which will cut past the depth of the stock and adhesive and into the MDF base. Each cut level is set to 0.010" for a total of 6 cut levels per profile with Cut Levels Orders set to Depth First. Each cut level entry is a 10 degree Along Path motion at a height of 0.012". Arc Fitting is enabled with a Fitting Tolerance (t) of 0.0002 and with a minimum distance sort.
- C. Here we see the in-process stock cut material simulation of the 2½ Axis Profiling operation on mother-of-pearl.
- D. The actual completed mother-of-pearl stock is shown on the MDF base.





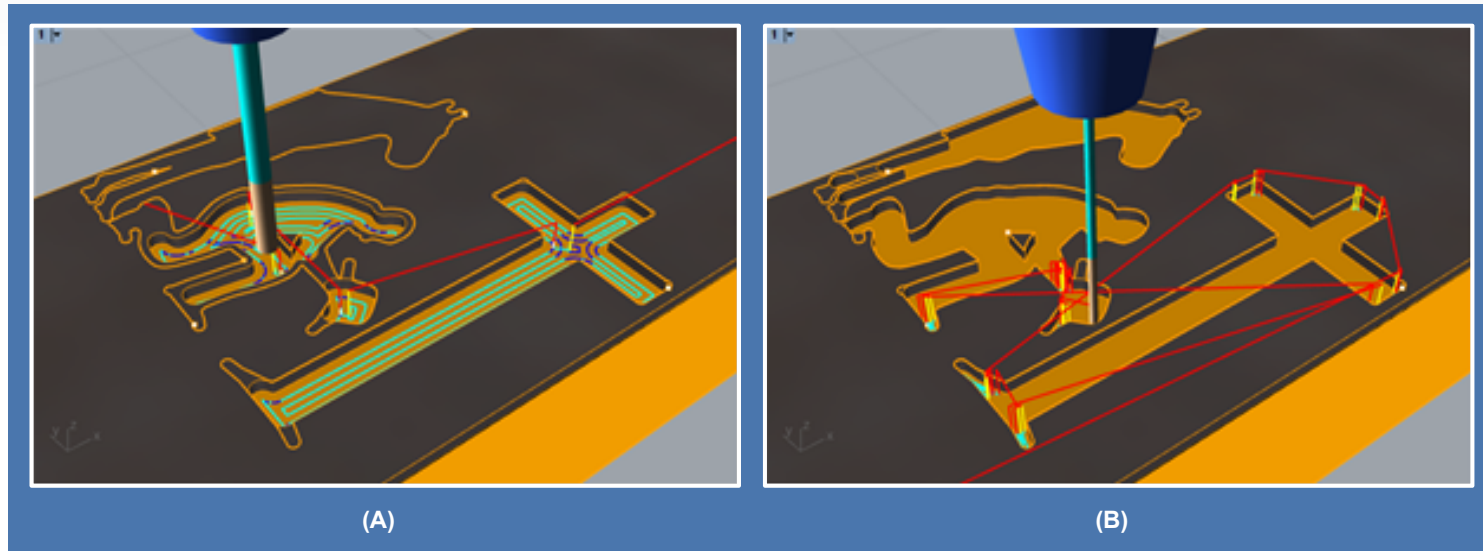
## Cutting the Inlay Pockets

The inlay pockets are cut into the fretboard at a depth of 0.046" (the same height as the mother-of-pearl stock). The inlay pocket perimeters are cut 0.004" wider than the mother-of-pearl inlays (see [Mother-of-pearl Inlay \(2½ axis Machining\)](#) above). this allows for tolerances and adhesive. The following images illustrate the 2½ Axis Pocketing and the 2½ Re-Machining operations used. The Machining Job tree is also shown here.



- A. This image shows the planar 2D curves and the initial 2½ Axis Pocketing toolpath for the inlay pocket on the fretboard using a 0.0625" flat end mill. The Tolerance is set to 0.0001, stock is zero, a Climb Cut Direction and 40% stepover.
- B. This image shows the 2½ Axis Re-Machining operation using a 0.024" diameter end mill. The re-machining toolpath is calculated to remove only the in-process stock left over from the larger tool of the previous operation (0.0625" diameter).



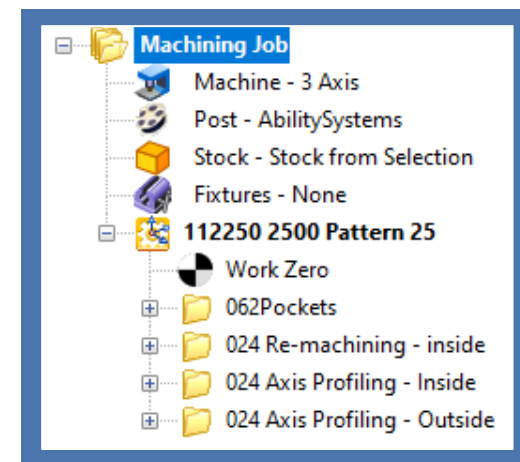


### Strum Hollow & Tail (3 Axis Machining)

The strum hollow and tail portions of the fretboard require 3 Axis machining operations. They take advantage of the roughing capability incorporated into RhinoCAM's 3 Axis Parallel Finishing toolpath strategy. They also illustrate some *Best Practices* for 3 Axis machining such as using masking surfaces to guide the toolpaths over and around critical areas and the use of overlapping closed 2D planar containment regions. On the left below we see the completed fretboard shown on the CNC machine table. The final assembled dulcimer is shown with the fretboard strum hollow and tail clearly shown.



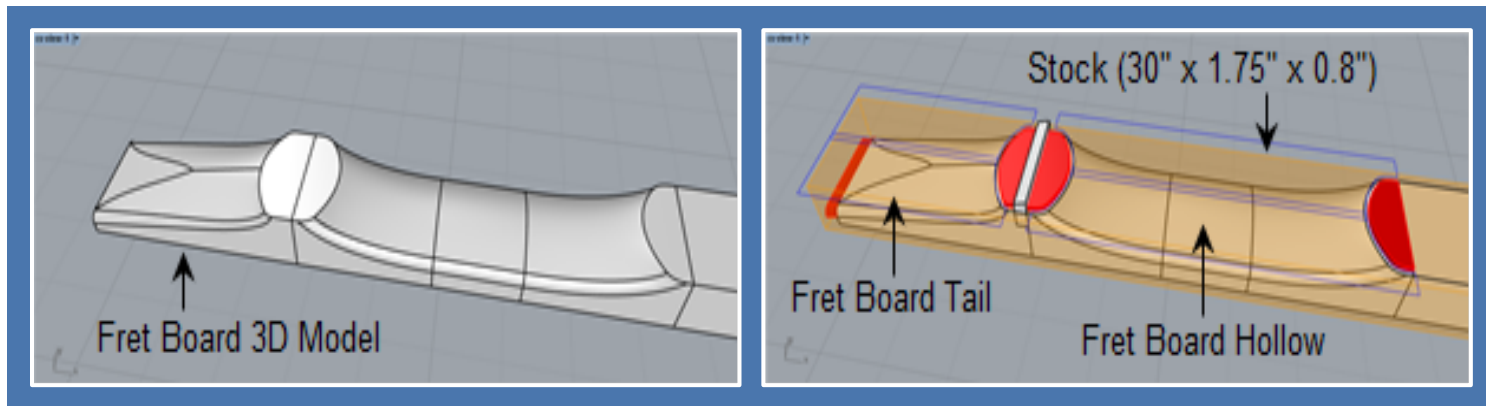
The machining job tree shown here includes the toolpath operations for the fretboard tail. Two 3 Axis Parallel Finishing operations are used for roughing and two are used for finishing. The strum hollow uses separate but identical operations. All dimensions mentioned are in Inches.





## The Part & Stock Models

In the left side image below we see the 3D surface model of the fretboard in Rhino. On the right we see the stock model (30" x 1.750" x 0.8") shown translucent over the part model. The surfaces shown in red serve the purpose of protectively masking critical edges that Terry wants to keep the tool away from. While in 3 Axis, RhinoCAM incorporates automatic gouge-free machining of all visible surfaces. However, masking certain critical edges prevents the tool from "riding on or over edges" that must remain clean and unaffected by cutting tolerances.



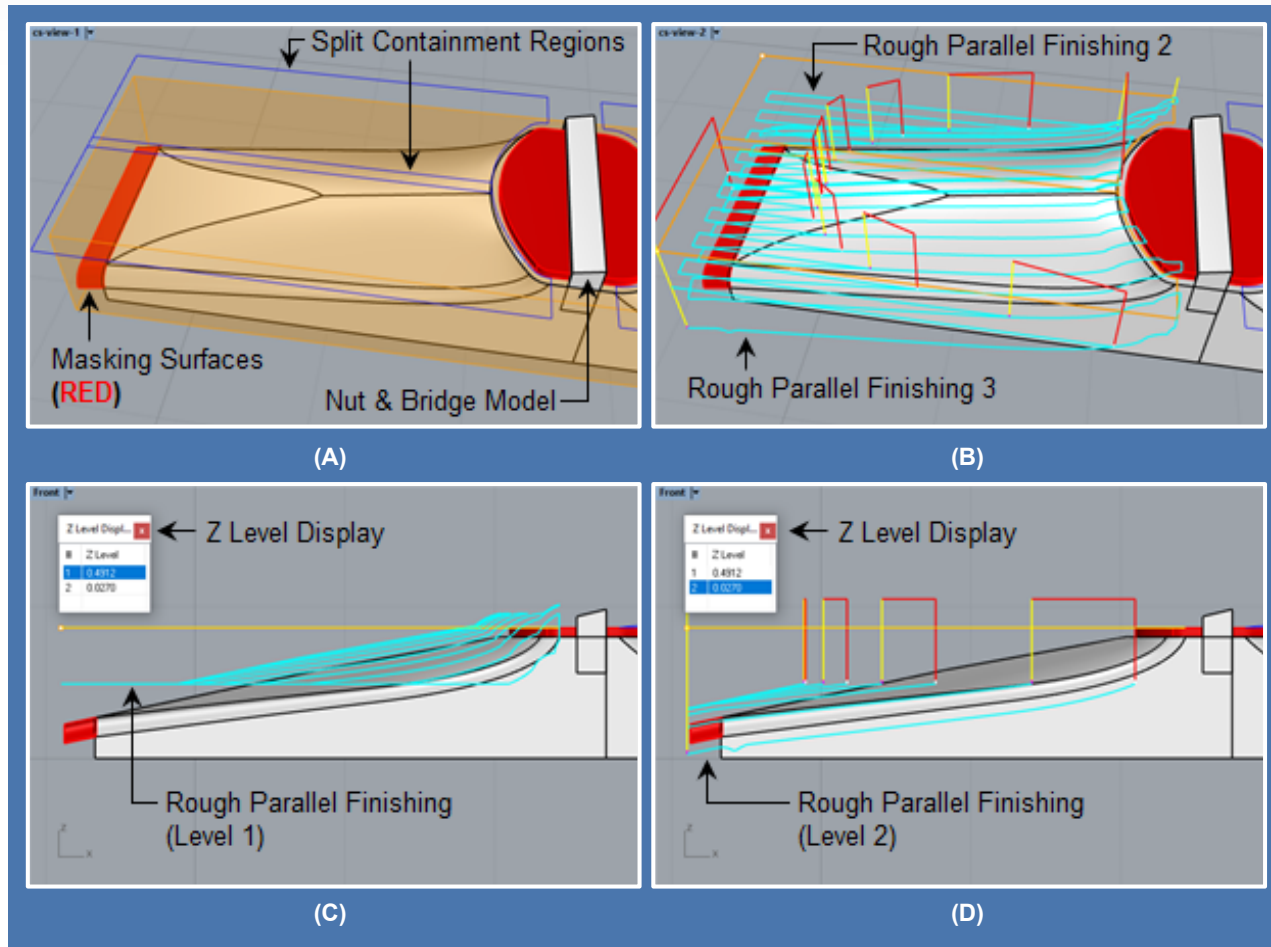


### 3 Axis Rough Parallel Finishing

To rough out the fretboard stock, Terry uses four 3 Axis Parallel Finishing operations, two for the strum hollow (right & left) and two for the tail (right & left). The stock allowance parameter and the Step-down Z Cuts option on the Z Containment tab of the Parallel Finishing operation are used for roughing. For this job Terry is using 2 cut levels. You can refer to the image descriptions below for more cutting details.

- A. Here we see a closeup of the fretboard tail as well as the planar split right and left 2D closed curve containment regions. The regions overlap 0.10" along the center line and are used to contain each 3 Axis toolpath. We also see a closeup of the masking surfaces (shown in Red). The surface that extends past the end of the tail will keep the tool from rolling over the edge, producing a nice even edge. The other masking surfaces perform a similar function. Also shown as reference is the Nut & Bridge model.
- B. Here we see both Rough Parallel Finishing operations (right & left) using a 1/2" diameter ball mill at a stepover of 25% and a mixed cut direction. When both operations are selected from the Machining Job tree both are displayed together on the part.
- C. The 3 Axis Parallel Finishing operation supports multiple Z stepdown levels making the operation ideal for roughing tasks. In this image we see the Z Level Display dialog with the first of two cut levels selected. The remaining stock allowance is set to 0.1".
- D. Here we see the second rough cut level of the 3 Axis Parallel Finishing operations. Notice how the masking surface (shown in red) forces the cutting tool past the edge of the fretboard tail!



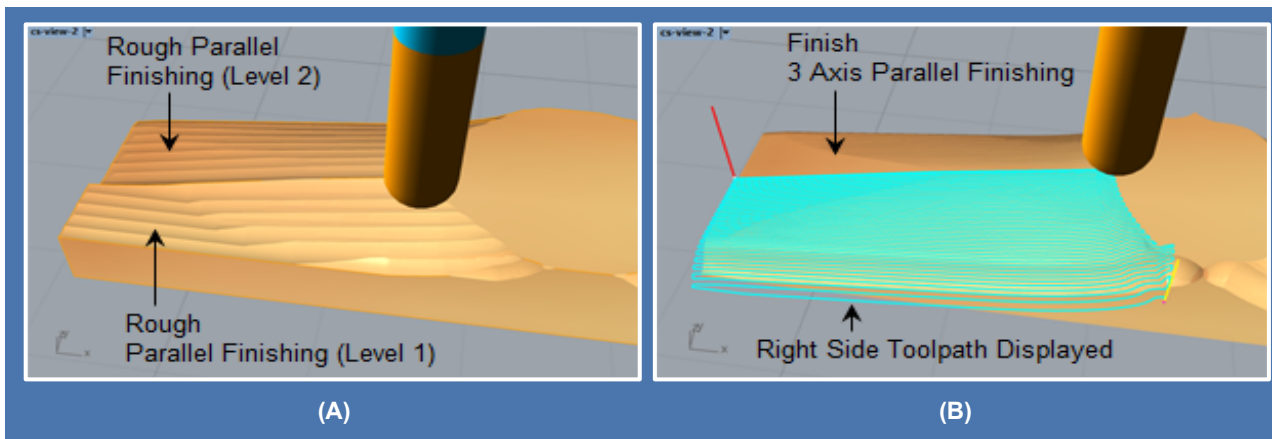




### 3 Axis Parallel Finishing

To finish the fretboard stock, Terry again uses four overlapping 3 Axis Parallel Finishing operations, two for the strum hollow (right & left) and two for the tail (right & left). These operations differ from the previous roughing operations. The stock allowance is set to zero and Step-down Z Cuts is disabled from the Z Containment tab.

- A. On the left we see the cut material simulation for the previous 3 Axis Rough Parallel Finishing operations with the remaining stock allowance set to 0.1". It shows the right-side operation at cut level 1 and the left side operation at cut level 2. The two right and left cuts overlap by 0.10" along the centerline.
- B. On the right we see the final cut material simulation for the 3 Axis Parallel Finishing operation with the remaining stock allowance set to zero but with Step-down Z Cuts disabled. The stepover is set to 5% (0.025").





## More Studio Pics

Here are some additional images from Terry McCafferty's studio. For more studio pics from Terry McCafferty we invite you to visit him online at [mccaffertydulcimers.com/shop](http://mccaffertydulcimers.com/shop)

We want to extend a special thanks to Terry McCafferty and McCafferty Dulcimers for allowing us to showcase their work! Enjoy the craftsmanship!







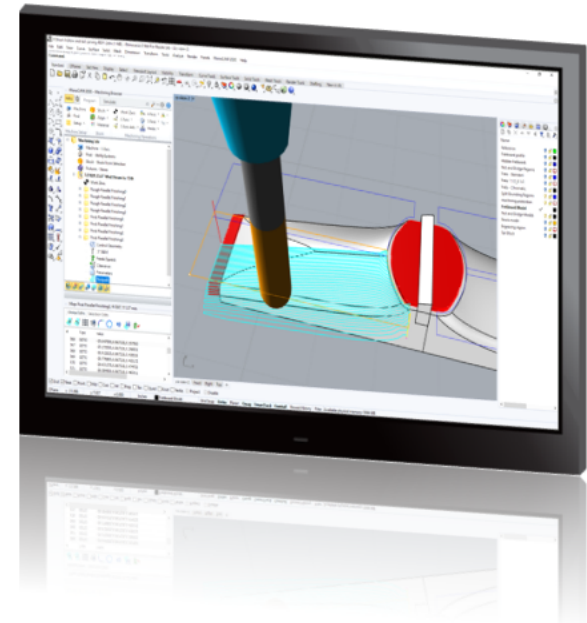
## More about McCafferty Dulcimers

For more information about Terry McCafferty and the quality Appalachian dulcimer instruments that he crafts we invite you to visit him online at [mccaffertydulcimers.com](http://mccaffertydulcimers.com) and on Facebook at [facebook.com/mccaffertydulcimers](https://facebook.com/mccaffertydulcimers)

## More about RhinoCAM Configurations

RhinoCAM - MILL is available in 5 different configurations (Express, Standard, Expert, Professional and Premium). The part shown here was programmed using the Standard configuration. Here are some additional details about each of the available configurations. For the complete features list we invite you to visit the [RhinoCAM Product Page](#).

- **RhinoCAM MILL Express:** This is a general-purpose program tailored for hobbyists, makers and students. Ideal for getting started with CAM programming. Includes 2 & 3 axis machining methods. Includes ART & NEST modules as well!







- **RhinoCAM MILL Standard:** This configuration includes everything that is in the Express configuration and additional 2-1/2 Axis, 3 Axis & Drilling machining methods.
- **RhinoCAM MILL Expert:** Suitable for 4 Axis rotary machining. Includes the Standard configuration, plus 4 Axis machining strategies, advanced cut material simulation and tool holder collision detection.
- **RhinoCAM MILL Professional:** Ideal for complex 3D machining. Includes the Standard and Expert configuration, plus advanced 3 Axis machining strategies, 5 Axis indexed machining, machine tool simulation, graphical toolpath editing and a host of other features.
- **RhinoCAM MILL Premium:** Tailored for complex 3D machining with both 3 Axis and full 5 Axis methods. Includes the Standard, Expert and Professional configurations, plus 5 Axis simultaneous machining strategies.
- **Active Annual Maintenance Subscription (AMS):** Bonus modules include: Profile-NEST (nest 2 Axis profile toolpaths onto sheets), MILL-TURN (program integrated milling & turning operations) and G-Code Editor (load, back plot, simulate and edit g-code files). Note that bonus modules are configuration dependent.



For the complete features list, we invite you to visit the  
[RhinoCAM Product Page: mecsoft.com/rhinocam](https://mecsoft.com/rhinocam)

**Try RhinoCAM Today!**

Powerful production CAM for Rhino users!

McCafferty Instruments, LLC uses RhinoCAM to generate the toolpaths needed to manufacture their Appalachian dulcimers.

Want to see how RhinoCAM can help you? [Click Here](#) to download a demo!