

Multi-color Image Carving with Resin Inlay

Step-by-Step Tutorial

(by Gert Burkhardt, Jan. 2021)

This tutorial describes the process steps to create resin inlays that can mimic color photographic images (black/white as well). The method is based on carving a height map corresponding to the intensity of a color component (or color channel) into a solid material and then filling the carved recesses with pigmented epoxy resin. Doing this in subsequent steps for all 4 color channels of an image (cyan/magenta/yellow/black) can create a recognizable copy of the original digital image. Be aware, though of the resolution limits due to the finite size of the carving bit. A very fine tipped tapered ball nose cutter (e.g. 0.25mm radius/15 degrees) is recommended.

As a base material, a good quality hardwood or solid plastic can be used. In case of sharp color edges or rapid color gradients, the method may create slim steep slivers of material while carving. Therefore, woods that tend to chip off or soft materials like MDF are not recommended. I have used Acrylic, Hard Maple and especially Bamboo Plywood with good success. For the epoxy pour, any clear tabletop resin can be used. I used "System 3 Clear Coat" (<https://www.amazon.com/gp/product/B00BR2KNVQ>), but there are cheaper resins that are about as good (<http://www.uscomposites.com/kk121.html>). For pigment I bought a set of color laser printer toner refill bottles (<https://www.amazon.com/gp/product/B01MZ2IR1C>)

If the base material is opaque (like wood), the resulting image will look rather like a regular photograph with some 3d or depth effect. If it is transparent or translucent (like acrylic or thin Corian), the resulting image may look like a regular lithophane or a stained-glass piece.

So...here we go. It may look a bit intimidating, but once figured out, the image preparation and model building takes maybe 20 minutes. Process is as follows:

1. Choose a suitable image
2. Split into four separate color channel images
3. Convert images to height maps
4. Import into Aspire and create vector boundaries
5. Create tool paths and export for CNC machine
6. Carve base material and pour black epoxy
7. Carve black epoxy and pour cyan epoxy
8. Carve cyan epoxy and pour magenta epoxy
9. Carve magenta epoxy and pour yellow epoxy
10. Mill and/or sand surface flush with base material edge
11. Polish and/or laquer surface

Step 1: Choose a suitable image

Process starts out with a good quality image, with moderate detail, good contrast and vivid colors. It should ideally have a resolution of 500 to 1500 pixels. If there is too much detail or steep color/brightness gradients, it will be difficult to reproduce even with a very thin tipped bit or create steep ridges that chip off easily.

Good pictures:



Not so good:

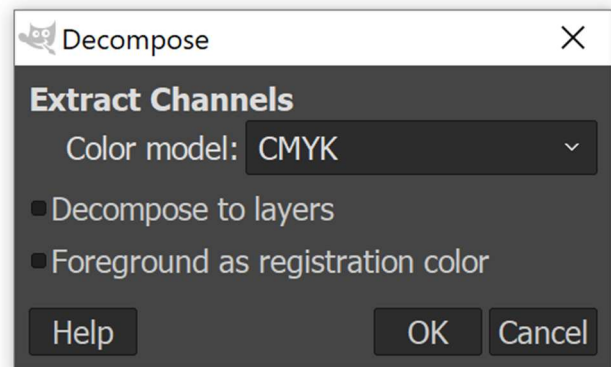
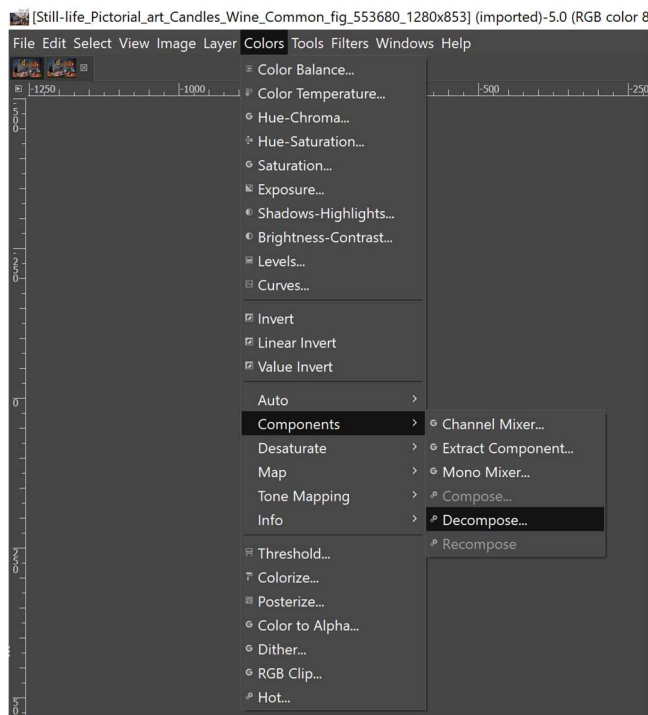


Step 2: Split into four separate color channel images

This recipe is based on the free photo editor GIMP ([download here](#)). It is a bit difficult to use but for this project only one function is needed. I know the channel split can be done with Photoshop as well.

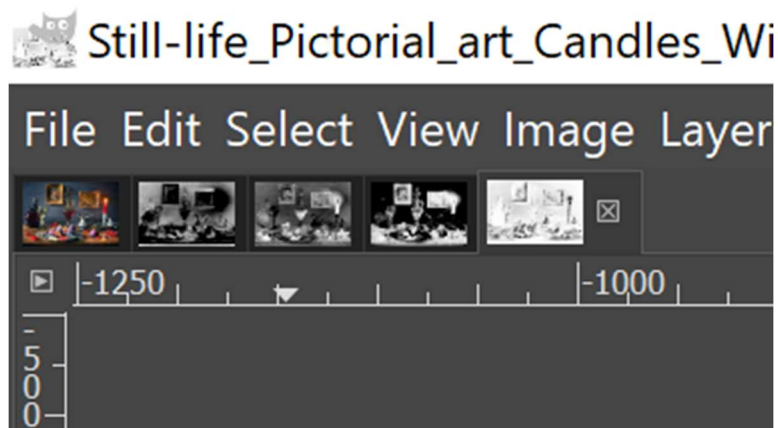
First load the chosen image into GIMP. You will be asked if to convert to RGB working space but I did not find a difference and suggest to click “keep”.

Then click menu item Colors/Components/Decompose to open following popup window



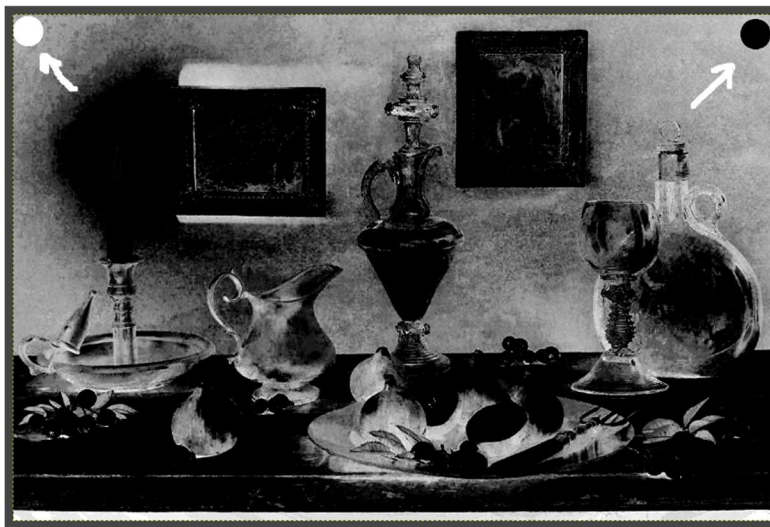
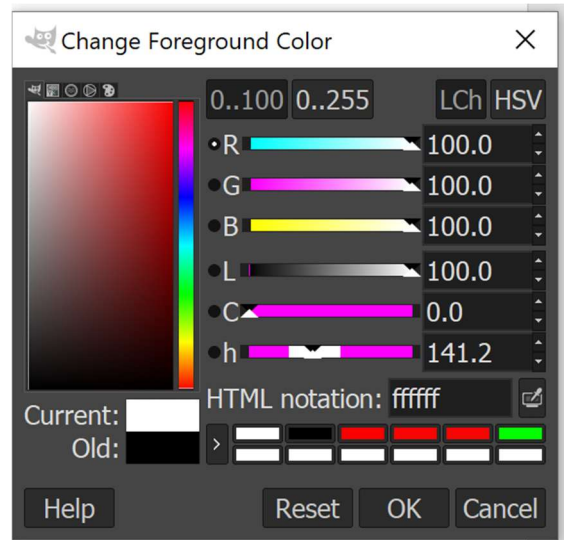
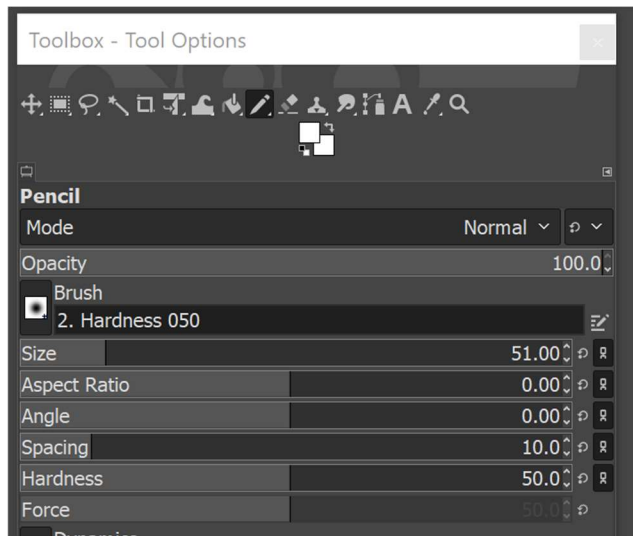
Select Color Model “CMYK” and deselect “Decompose to layers”, then click “OK”.

This will create 4 new images for the color channels, all represented in black and white. Thumbnails will show in the top left screen corner:



Now open each of these 4 images and set a fully black dot with the pencil tool in one corner and a fully white one into another corner. These dots will provide a reference for the full color range of this channel.

The dotted corners will be later excluded from the carving. If this is not desirable, the canvas must be expanded and the dots set outside of the actual picture but I have not tried that in GIMP.



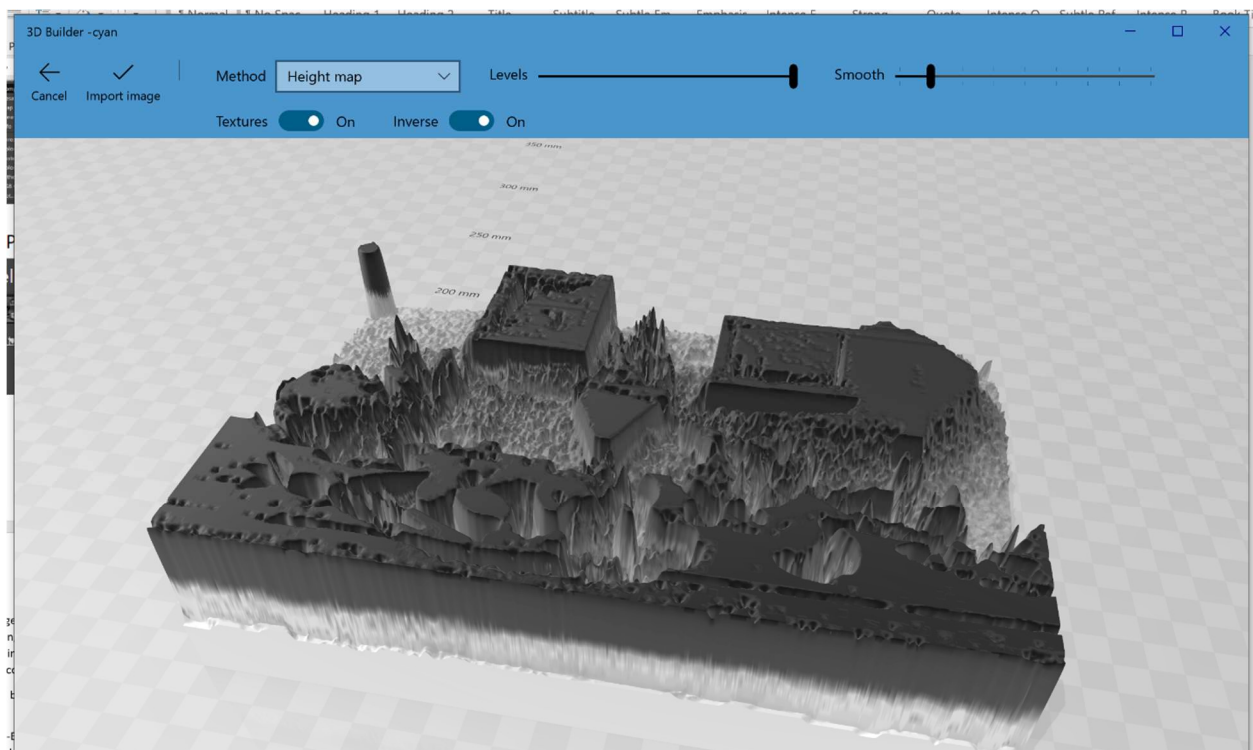
When this is done, save all 4 new images, e.g. as .jpg files.

Step 3: Convert images to height maps

This can be done using Aspire directly. However, I preferred using the free [Windows 3D-Builder](#). It came on my machine included with Win10 or it can be [downloaded from the Microsoft App Store](#). It gives more control for the conversion.

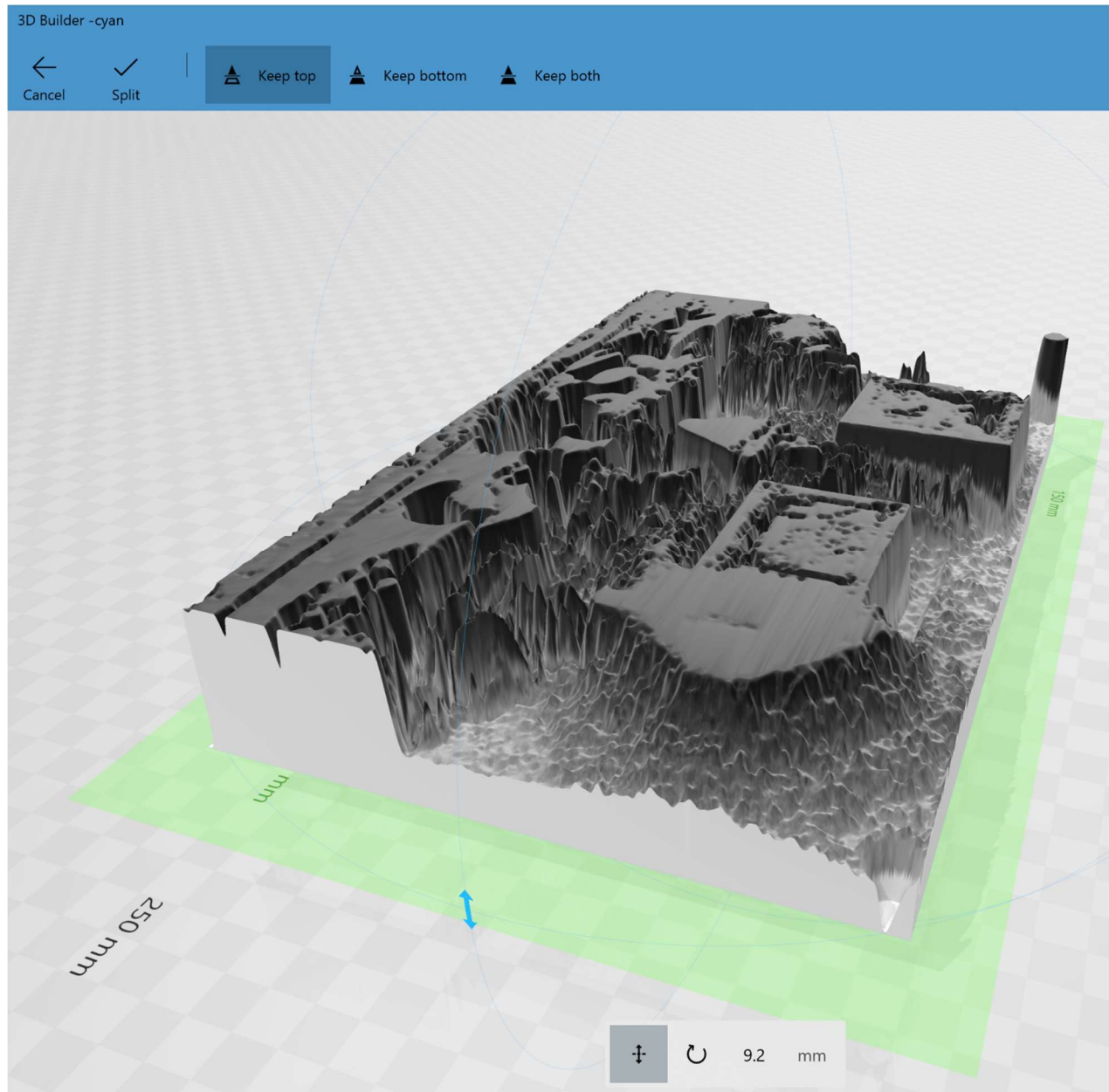
The following has to be done separately for each of the four color channel images, creating a set of 4 .stl models.


After start of the 3D-Builder, click the 3-line menu icon in the top left corner, then “Open”, then “Load Image” and select one of the four channel images. After that it should show a weird contour based model. Select method “Height Map” and “Inverse” “On” and it will look much more reasonable. Move the “Levels” slider to the far right and the “Smooth” slider to the 2nd lowest level (see below). Then click “Import”.

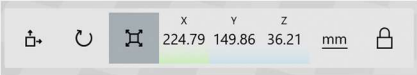


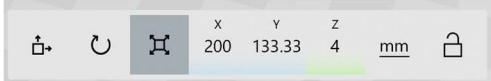
Notice the black dot makes the tallest level in the model and the white dot the lowest. Next step is to split the model so that the part below the white dot is cut away. For that click “Edit” and “split”. This will show a green plane where the split is to occur.

Click into the plane and move it up or down so that the split plane is just below the white dot pit. For fine tuning, edit the number in the box. For my example this happened to be about 9.2mm. Make sure there is no piece of the green plane visible in the white dot or you will have a hole in the model. Click “Keep Top” and then “Split” (picture on next page)



Click the “Move” button  and slide the newly split model down until it clicks onto the zero-plane

Now click the “Scale” button  and “lock” the aspect ratio and you can scale your x and y dimensions as needed in Aspire.

Then “unlock” the aspect ratio  and scale the z dimension to the required thickness of your color resin layer. A good value is 4mm for each layer when carving into a 19mm or ¾ inch blank.

Make sure you have not rotated or moved the model accidentally, then click the menu icon and “Save AS”, choosing “STL” format.

Do the same for all 4 channel images.

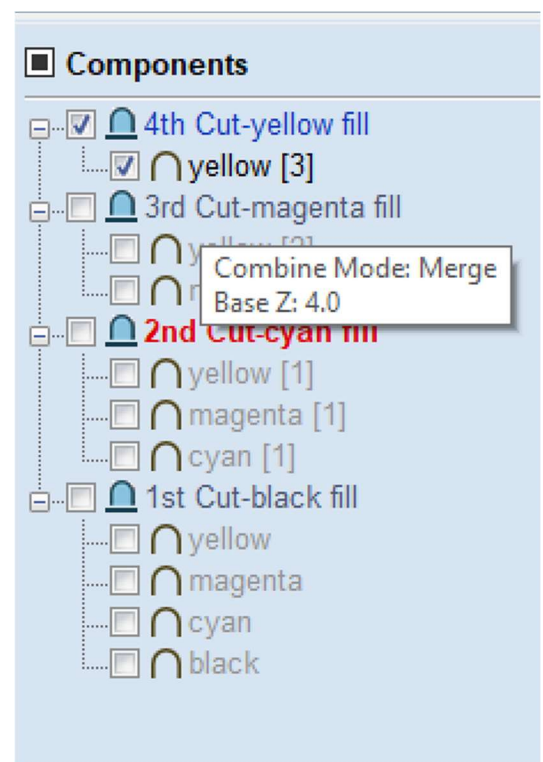
Step 4: Import into Aspire and create vector boundaries

Open Aspire and create a new empty file (one-sided) with the dimensions of your material. The material should be at least ½” larger all around than the previously created image models. It should be prepared with perimeter cutout and possible chamfers and cut. It is recommended to set zero to the lower left corner and create a fence so that the material can be removed from the CNC for epoxy casting and put back exactly in the same position. I used vacuum pod hold down, which makes for quick and precise positioning. I am not going into the details for the Aspire basics.

First import step is to select the “Model” tab and “Import component or 3d-model”. The model should be already in the correct orientation and size, so just click “center model” and make sure that “discard data below zero” is not checked. This will be the first model import, then go and import the other 3 color channel models the same way. I did this in the sequence black-cyan-magenta-yellow (same as the color casting sequence later) but believe another sequence will deliver similar results. All models should be grouped in one level with combine mode “add”.

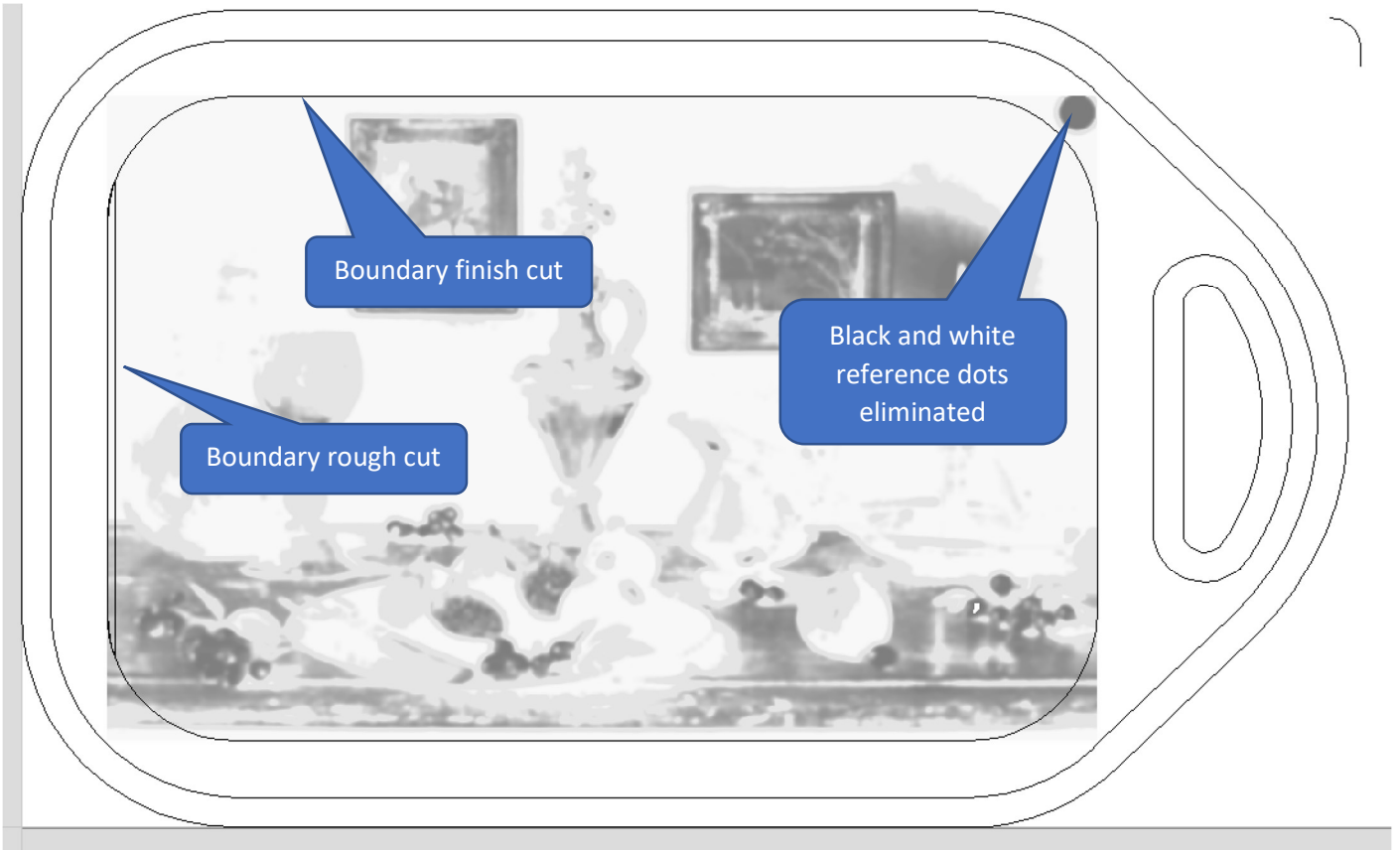
Next is to duplicate the models for cyan, magenta and yellow (not black) and move it into a new group level. Then duplicate magenta and yellow only into just another group level and finally duplicate yellow only into the 4th level, It is recommended to rename these levels reasonably.

The result for my example looked like this:



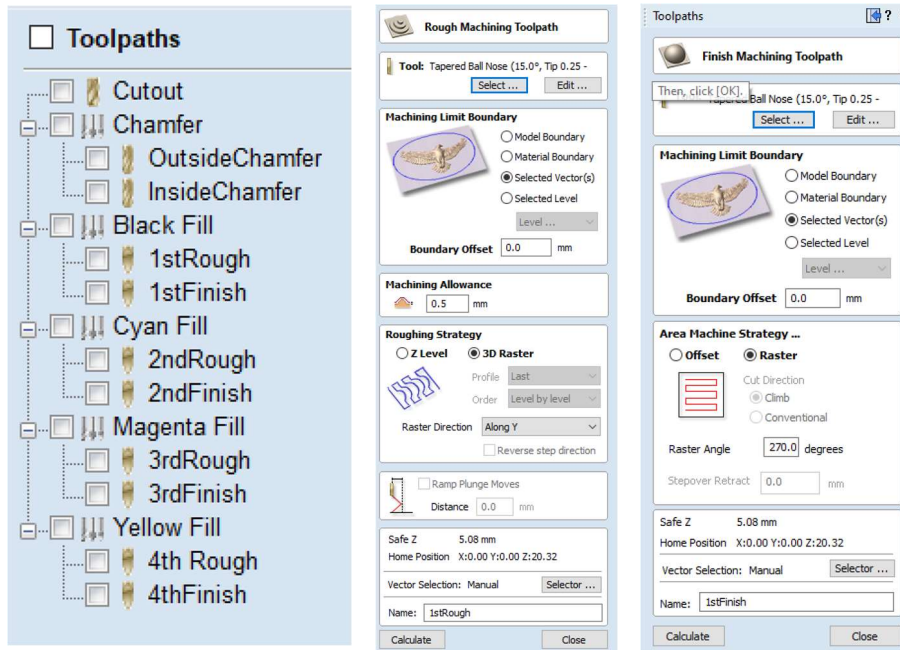
The combine mode for the levels is irrelevant since only one of them will be selected for each tool path.

I made boundary vectors for the 4 rough and finish cuts so that the previously mentioned black and white reference dots are excluded and not machined, using a rectangle with generously rounded corners. Note, the boundary vector for the rough cut is only a narrow slot located where the finish cut starts so that the bit will not snap when starting potentially at full depth. After that start, the finish cut is done for the entire area. Both rough and finish cut are done with the same 0.25mm radius tapered ballnose bit.



Step 5: Create tool paths and export for CNC machine

Tool paths are created for only one of the levels. Other levels must be de-selected. If Aspire suggests re-calculation all tool paths, decline or you will have to start over. Example:



Step 5.1 Carve base material and pour black epoxy

Export the first rough and finish tool path combined, load on the CNC, make sure to zero PRECISELY on the material surface with material against the fence and settled in the hold down.

Cut this color level (takes about 3.5 hours on my machine for this size). Remove all fuzz carefully with a wire brush or glass fiber pen, even within deep crevices. Be careful with rotary tools, you may quickly grind away critical details. In my experiments that was easier to do with the bamboo than with maple.

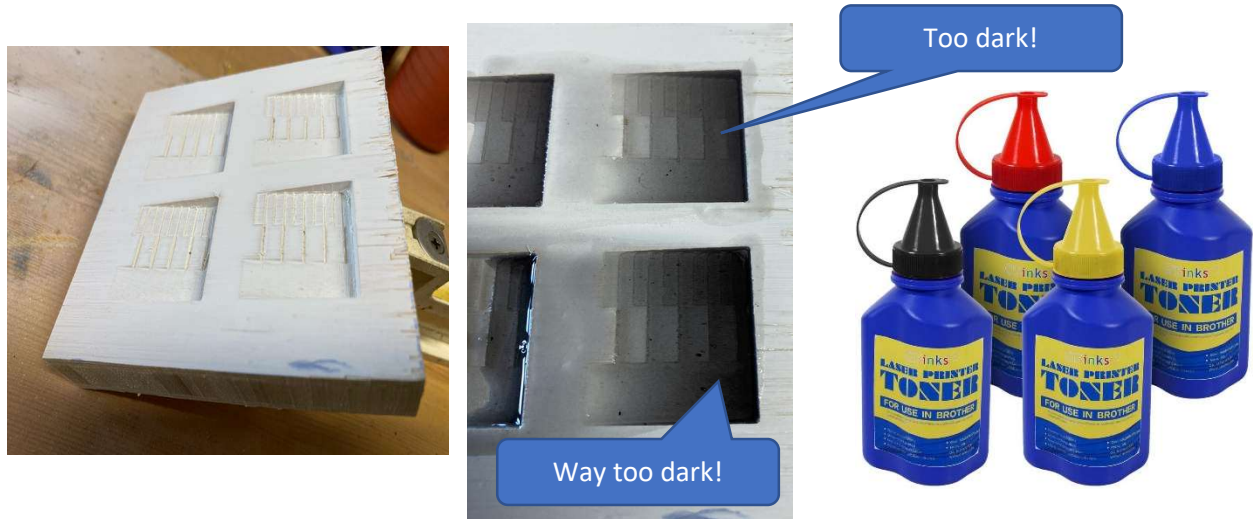
It is super important to spray paint the base material carving evenly with white paint so that the light has a chance to be reflected back to the surface (imagine the color toner applied to white paper in a printer). Let the paint dry well.

Prepare the epoxy. You may have to guess the required amount. Be generous as matching the color with a second batch is difficult.

After mixing the resin and hardener, add the black pigment. You will likely need only a pinch (or the very tip of a teaspoon) and it must be stirred extensively to avoid clumps and black specks.

It helps using a small calibration cavity like shown below. The cavities are max 4mm deep (same as the color channel 3d-models). Slowly add pigment, stir and put a few drops into the cavity until satisfactory.

The steps must be clearly distinguishable to the bottom. Should be lighter than shown below.



For the real pour, the resin must fill the base material carving completely up to the brim. A hot glue dam around the carving can help avoid a mess and gluing your material to the table.

Let the resin set completely (2-3 days at room temperature). Alternatively, after it gels and becomes rubbery put it in a toaster oven on "hold warm" at 125 F or 50 C for 2 hours to fully cure and then 15 minutes in the freezer to become hard again. Worked for me...

Step 5.2 Carve black epoxy and pour cyan epoxy

The resulting cast will look rather dark because it is black pigmented for all color layers. So that must be carved away. Select the tool path for Cyan color, place the material against the fence with same hold down force. I reset zero to the surface again, because the machine tends to move a little over the course of a few hours and a fraction of a millimeter can make a big difference. Then run the tool path to make space for the cyan pour. I noticed the hardened epoxy carves beautifully (better than any acrylic that I have used in the past) but there will still be some fuzz cleanup when finished.

Then mix the cyan pigmented epoxy in same fashion and pour. In my example I needed 80% of the black resin volume. Let cure like the black one.

Step 5.3 Carve cyan epoxy and pour magenta epoxy

Same procedure, but with Magenta pigment, using about 60% of the black resin.

Step 5.4 Carve magenta epoxy and pour yellow epoxy

Same procedure, but with Yellow pigment, using about 45% of the black resin.

Step 6 Mill and/or sand surface flush with base material edge

Especially the last pour must fill the remaining cavity completely or even with a little overfill. After hardening, remove the hot glue dam and sand down to be completely flush with the rim of the base material. I did a surface cut with an endmill first to save a lot of sanding, since I had some overflow over the edge. I started with 80 grit, then 220, then 400 on the ROS and checked with an eye loupe that all coarser sanding scratches were removed before moving on. I also hand sanded with wet 1000 grit.

Step 8 Polish and/or lacquer surface

The sanded surface gives only a weak clue of the final appearance. The surface must be really smooth. One could continue with polishing compound but most polishing/buffing compounds contain grease and may mess up the base material rim. I opted for the easier way with a heavy coat of gloss acrylic clearcoat enamel. I guess any kind of lacquer will do.

That is about it.

My example came out a bit too dark and too blue. I will go easier on the pigments next time.



The same can be done with a black&white picture and that needs only a fraction of the effort. Differences are:

- No color channel separation is needed (forget the GIMP procedure)
- Same procedure in 3d-Builder as described earlier, loading the picture directly, but keep the "Reverse" feature turned "Off"
(a normal B/W picture is not a negative unlike the CMYK color channels)
- Only one model to import and one set of tool paths. The model height (or carving depth) should be around 6-15 mm.
- Only one pour with black pigment. This could be the black printer toner or other types of pigment. I have used rottenstone powder or mica based color pigments with success. I can imagine glitter may create some interesting effects as well. If using a calibration gadget, the depth should be the same as the model height.

For carvings in translucent or transparent base material to achieve a lithophane or stained-glass effect, it is probably better to use more pigment, since the light has to go through the color layers only once. Obviously, the first carving in such material must not be painted white.