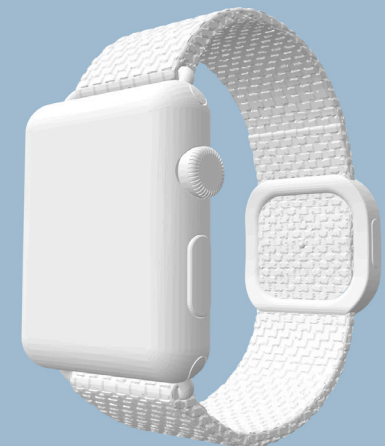
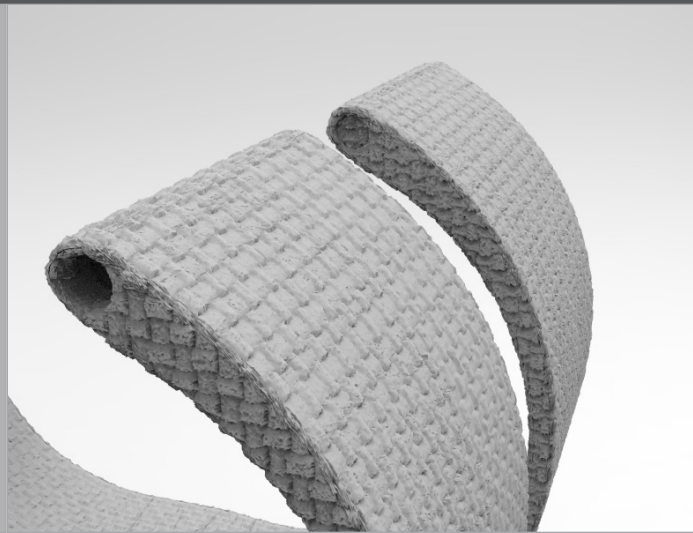


Digital Modeling Series

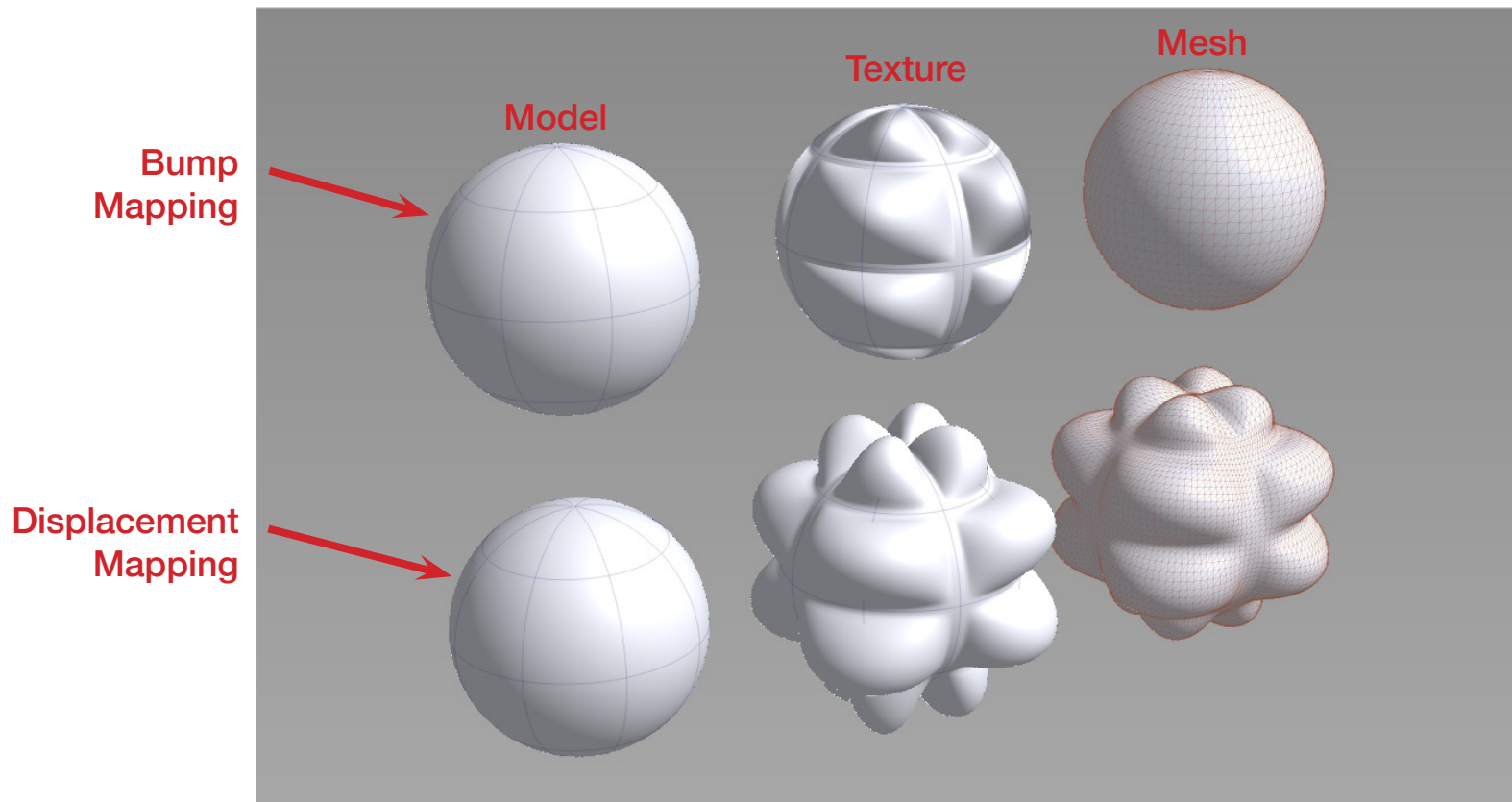
Creating and Printing 3D Textures

This tutorial will cover the process of creating a 3D texture in KeyShot or SolidWorks and then saving out the texture in the stl model for 3D printing. The tutorial starts off with an introduction about bump mapping vs. displacement mapping, the settings for displacement mapping and some of the potential issues with creating a texture. Next, the process of creating the texture in KeyShot and SolidWorks will be demonstrated.



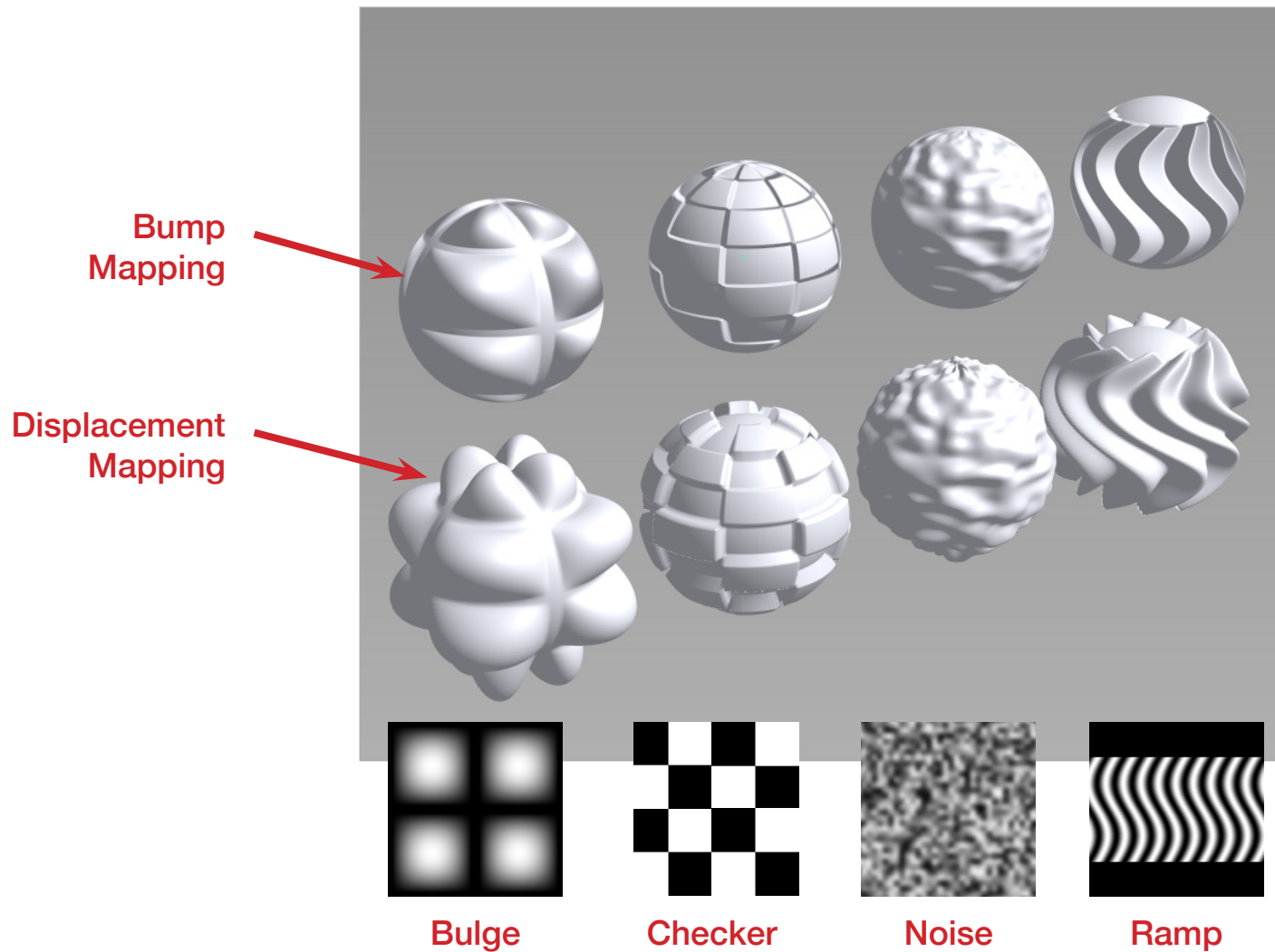
Bump vs. Displacement Mapping

Bump and displacement mapping can both be used in the rendering process but can result in very different outcomes. Bump mapping has been used to “fake” in 3D textures. It typically renders quicker, can represent 3D textures well, but looks fake around the edges of the form. This is illustrated in the first row. Displacement mapping will actually change the 3D form. The same texture is applied to the displacement channel. The 3D form is changed because of this. The last column shows what happens when the object is converted to a mesh shape.



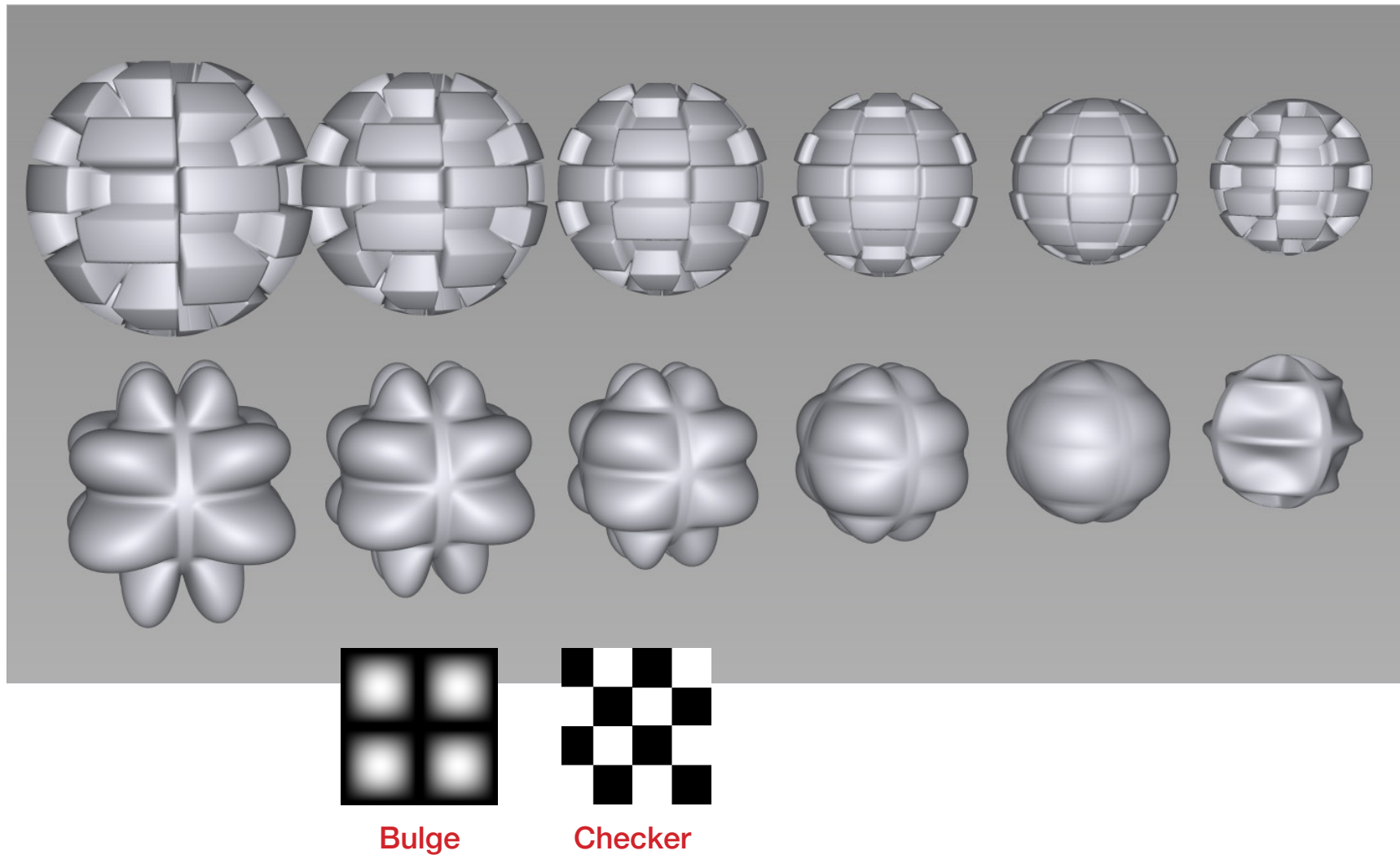
Displacement Textures

The images below each column represents the texture that was used to create the 3D patterns in either bump or displacement mapping.



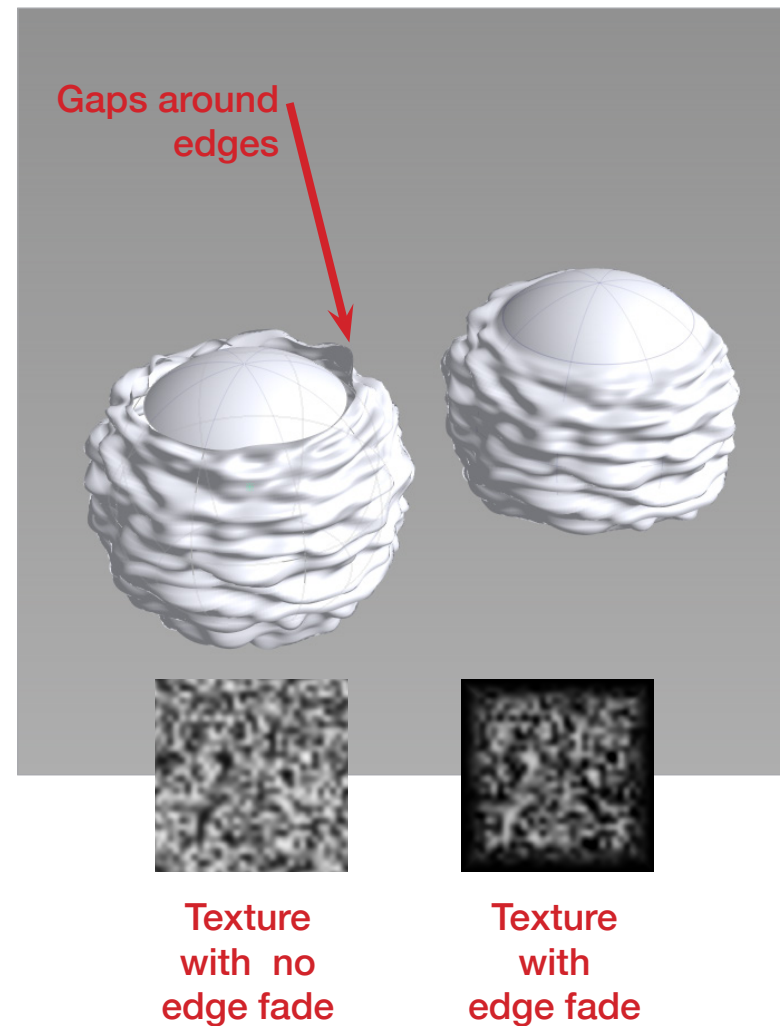
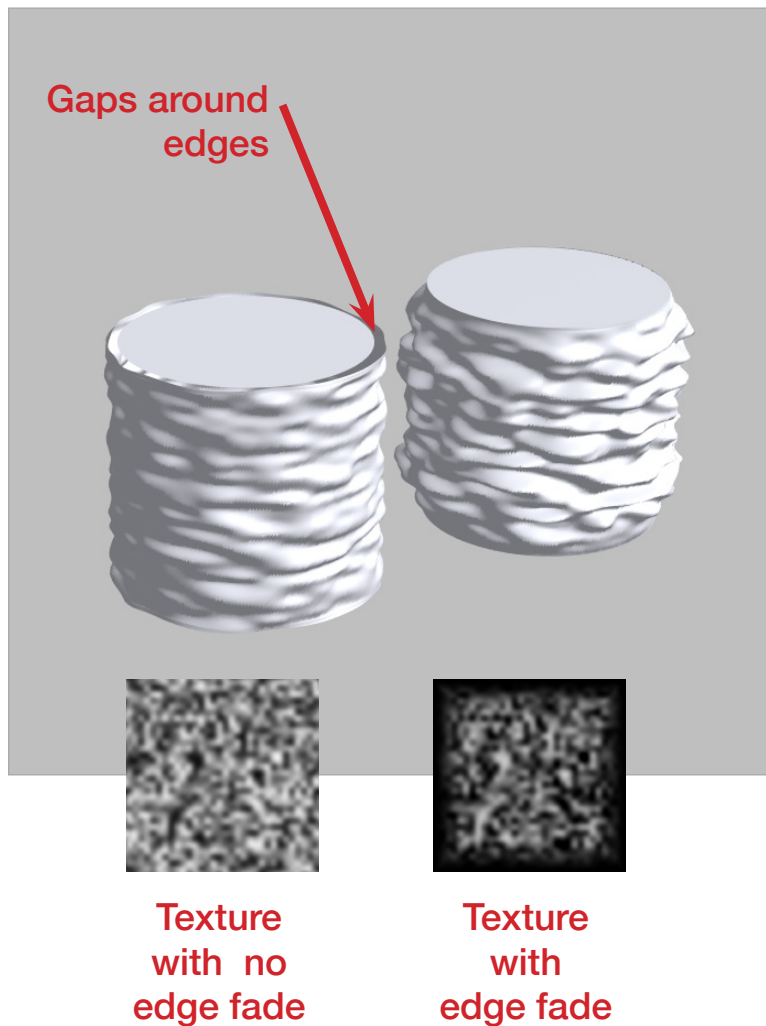
Intensity Value

The amount that the pattern effects the geometry is the intensity value or displacement height. In this image, both rows are displacement mapping. The top row uses the checker pattern while the bottom row uses the bulge pattern. The intensity value starts at 1 in the far left column and reduces to .1 in the 5th column. Negative values can be used to reserve the direction of the geometry. The value in the far right column is negative .5.



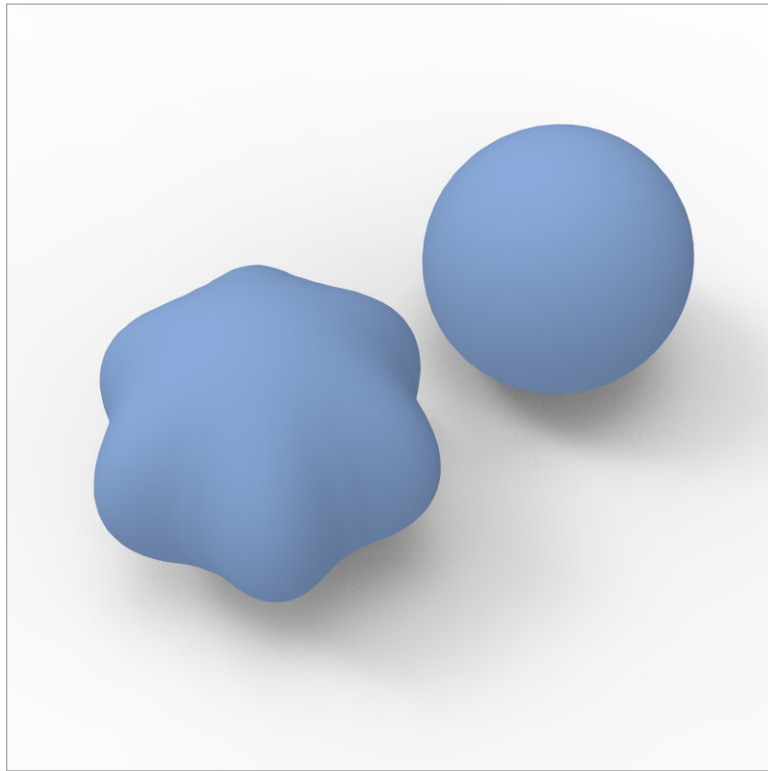
Issues with Displacement Mapping

One issue with displacement mapping is the gaps that appear between surfaces or around the edges. Below are two examples of this issue. The objects on the left in each image have this issue. A possible fix is to add an edge fade to the texture. The objects on the right in each image have this texture applied for the displacement mapping. The edges of the displaced geometry matches the other geometry.

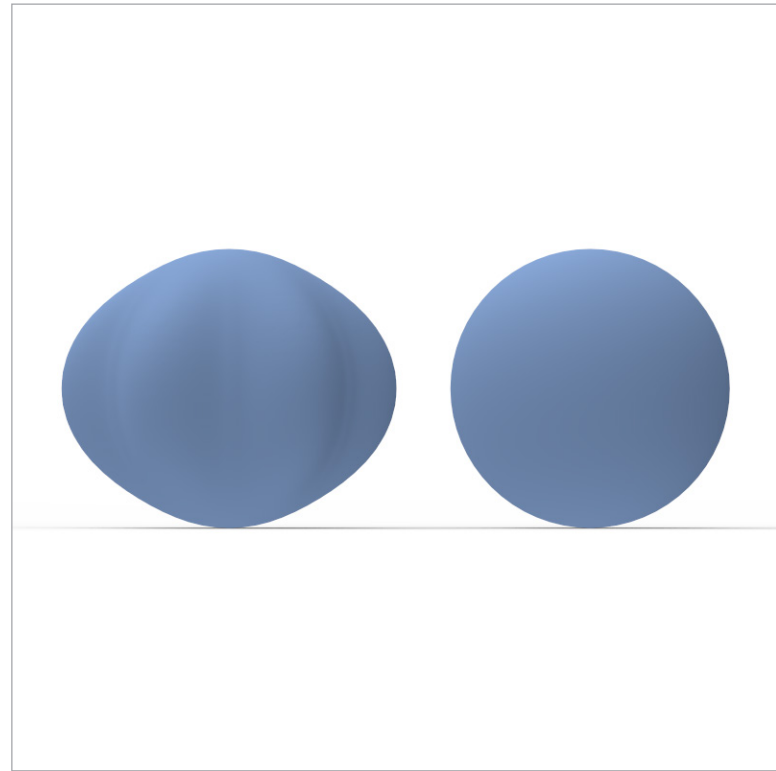


Issues with Displacement Mapping

A second issue with displacement mapping is geometry can change size. Since the geometry is physically being moved, displacement mapped forms typically grow in size. The images below illustrate this issue. Keyshot does provide a setting that can be used to shrink the form back to shape.

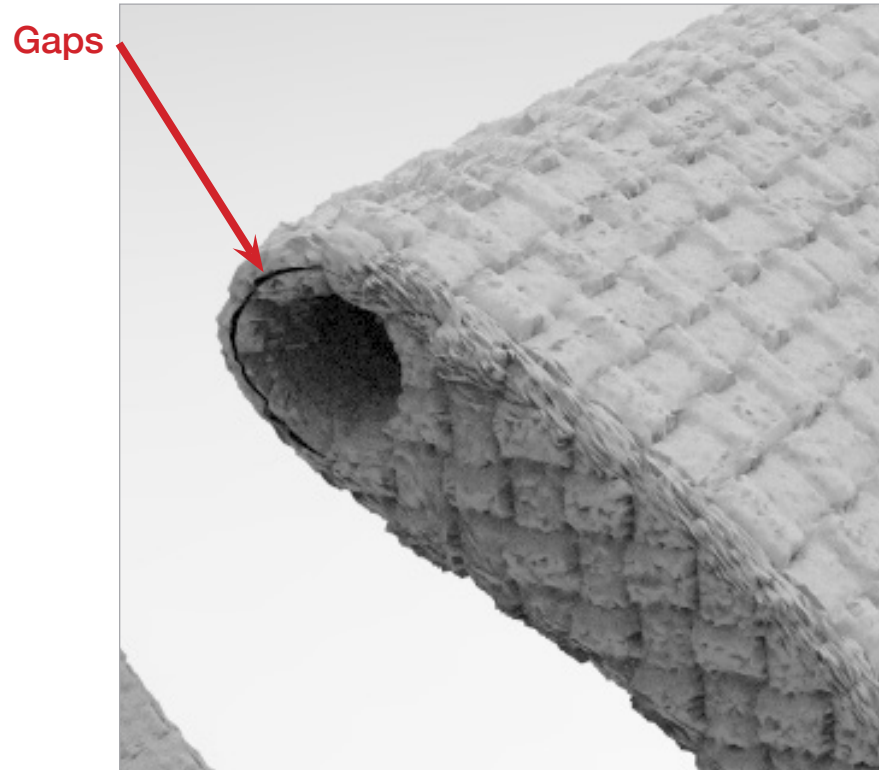


A bulge pattern was added to the circle on the left. The size grows larger around the circumference since the bulge is the highest value in this area.

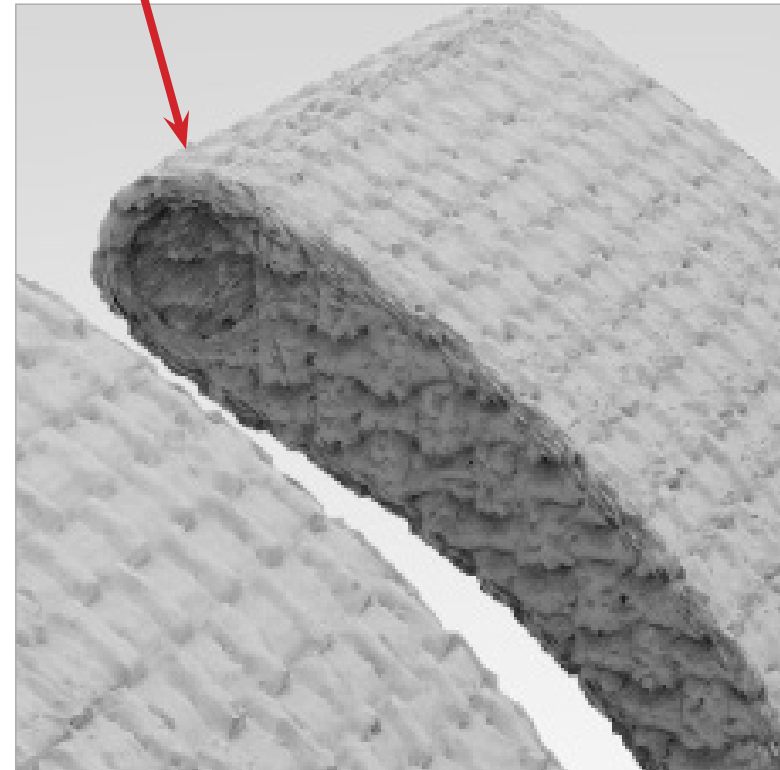


Issues with Displacement Mapping

A third issue with displacement mapping is that gaps in the displacement can cause printing issues. A possible solution is to re-model the form.



**Hole in the form
was filled**



Displacement Mapping in Keyshot

Keyshot added the functionality to use a texture source to create 3D textures for rendering. These can be exported into a STL model for 3D printing. There are a several different techniques to that can be used and require several steps.



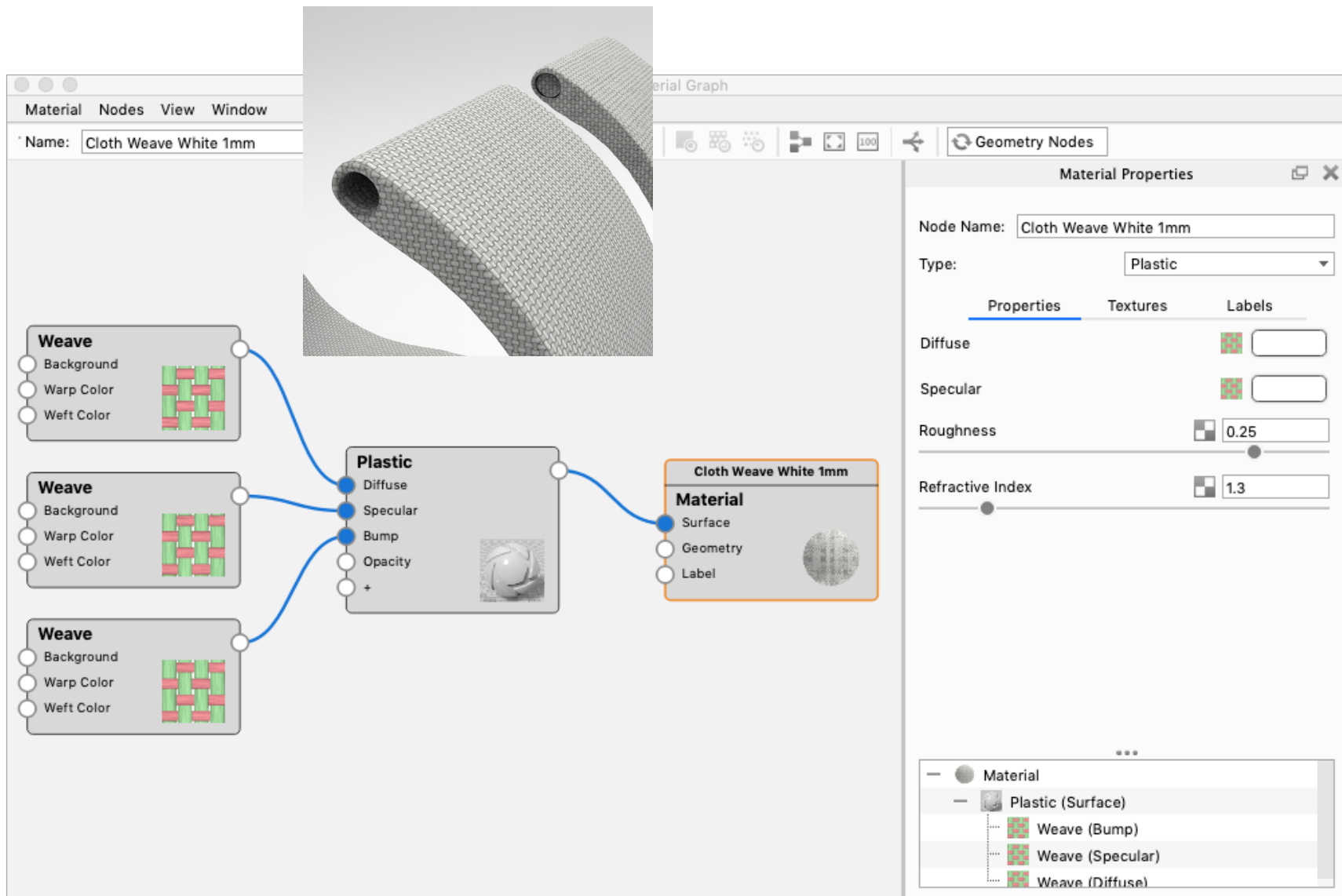
Keyshot model with textures



3D printed model with textures

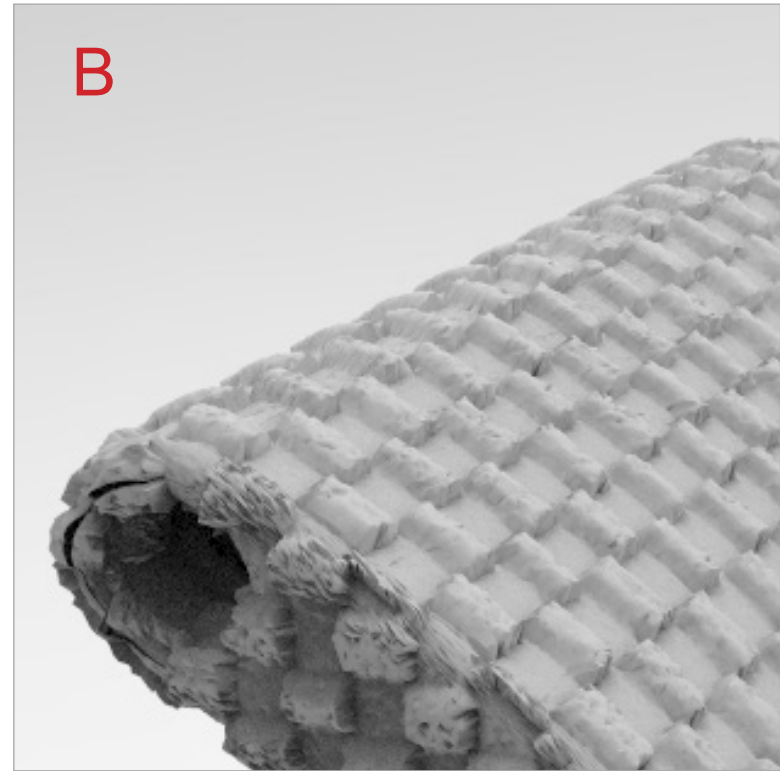
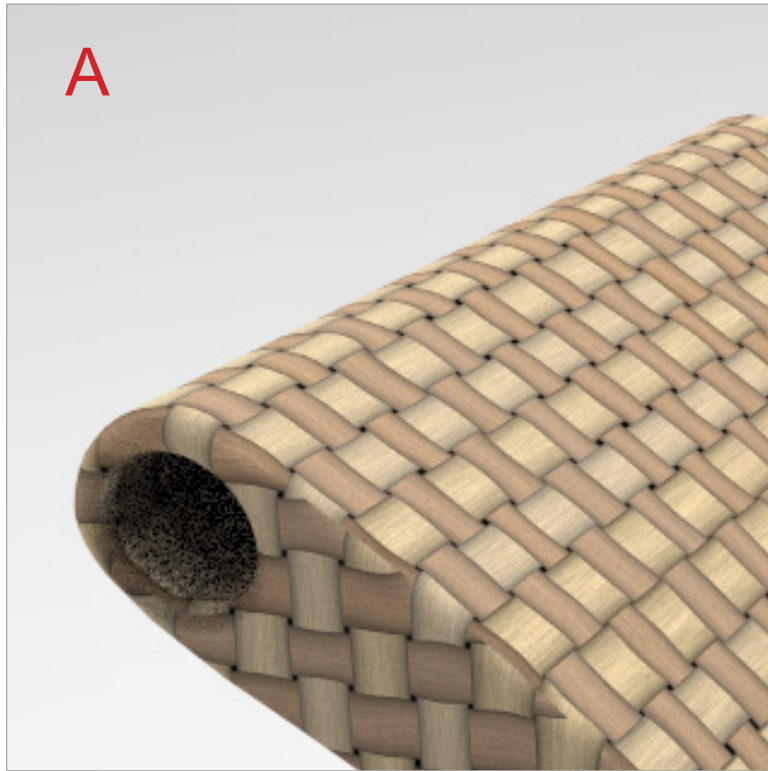
Keyshot - 3D Mapping using Existing Material

Step 1 Assign an existing material that has a texture source similar to the one for 3D printing. In this example, the Weave material is assigned. Make basic edits to align and size the texture.



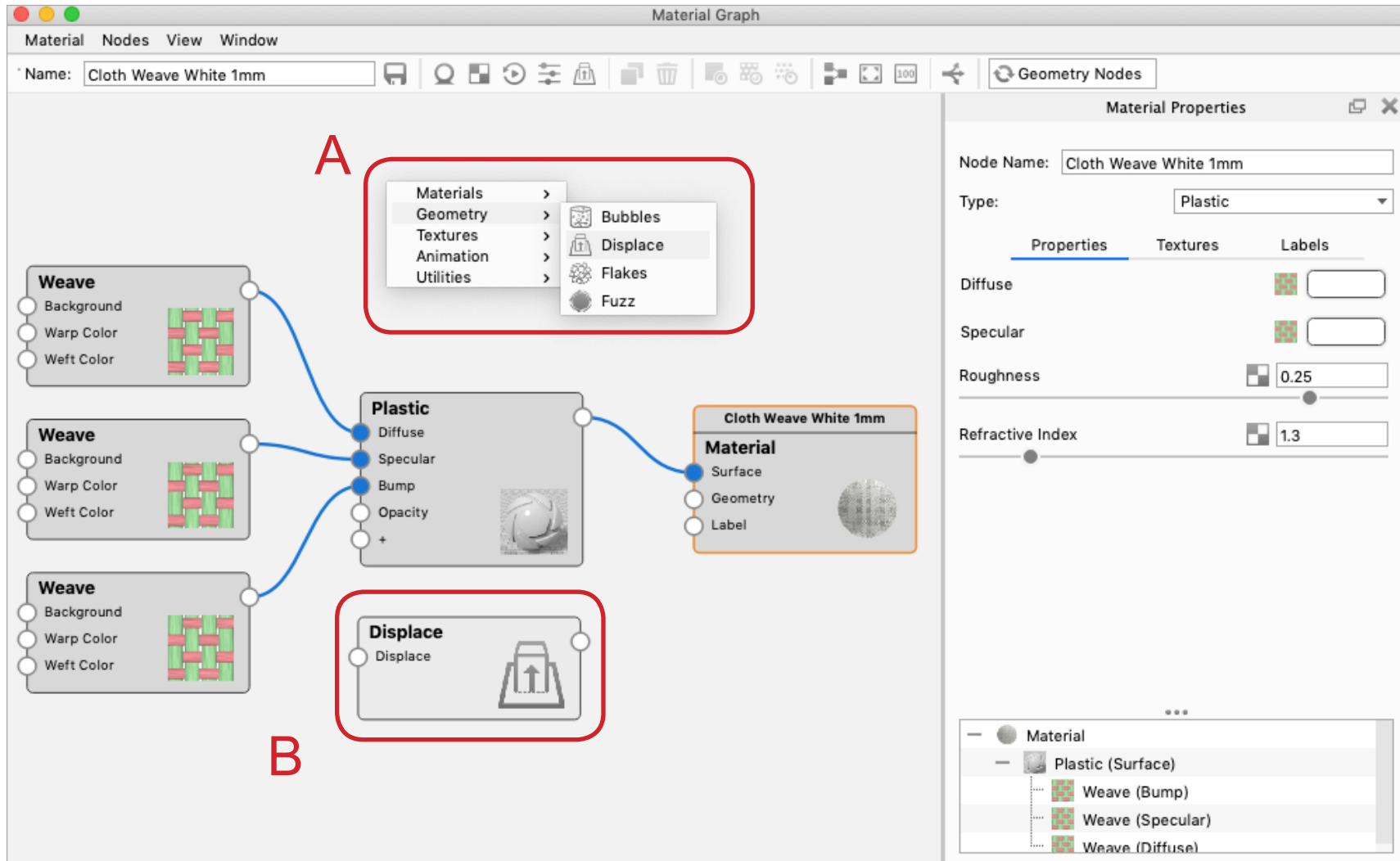
Keyshot - 3D Mapping using Existing Material

Step 2 When the texture pattern is converted into a 3D texture, it does not match the 2D texture map exactly. Also, the texture pattern cannot be too small or details will not be defined. It is best to enlarge the 3D texture pattern to address these issues. Image A shows the enlarged 2D texture while image B shows the initial 3D conversion.



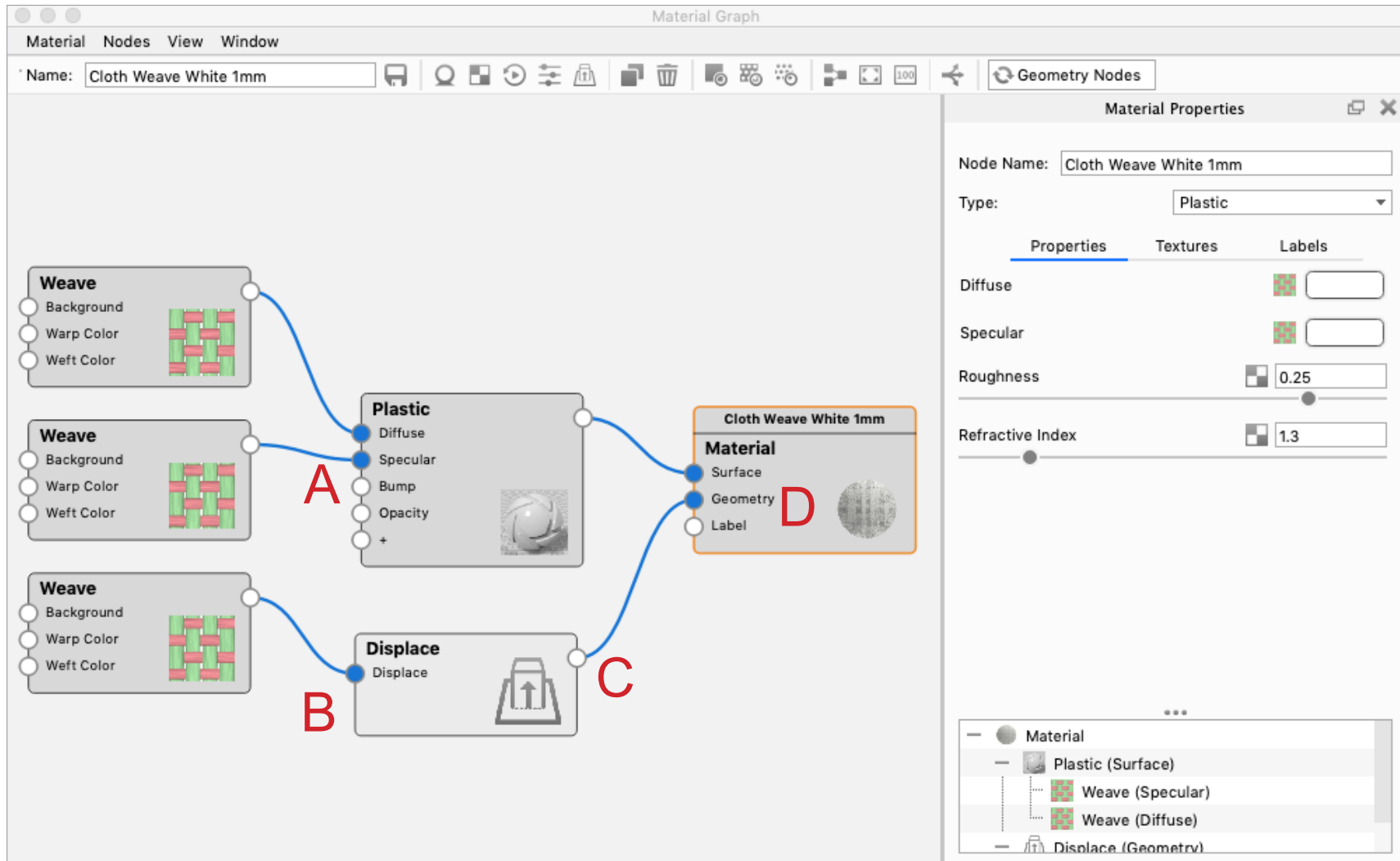
Keyshot - 3D Mapping using Existing Material

Step 3 Open the Material Graph window from the Material panel. The graphs elements in the window are known as “nodes”. A new node needs to be added for the Displace Mapping. Right mouse click in the open area and select Geometry > Displace (A). Drag the Displace node below the material Type node (B).



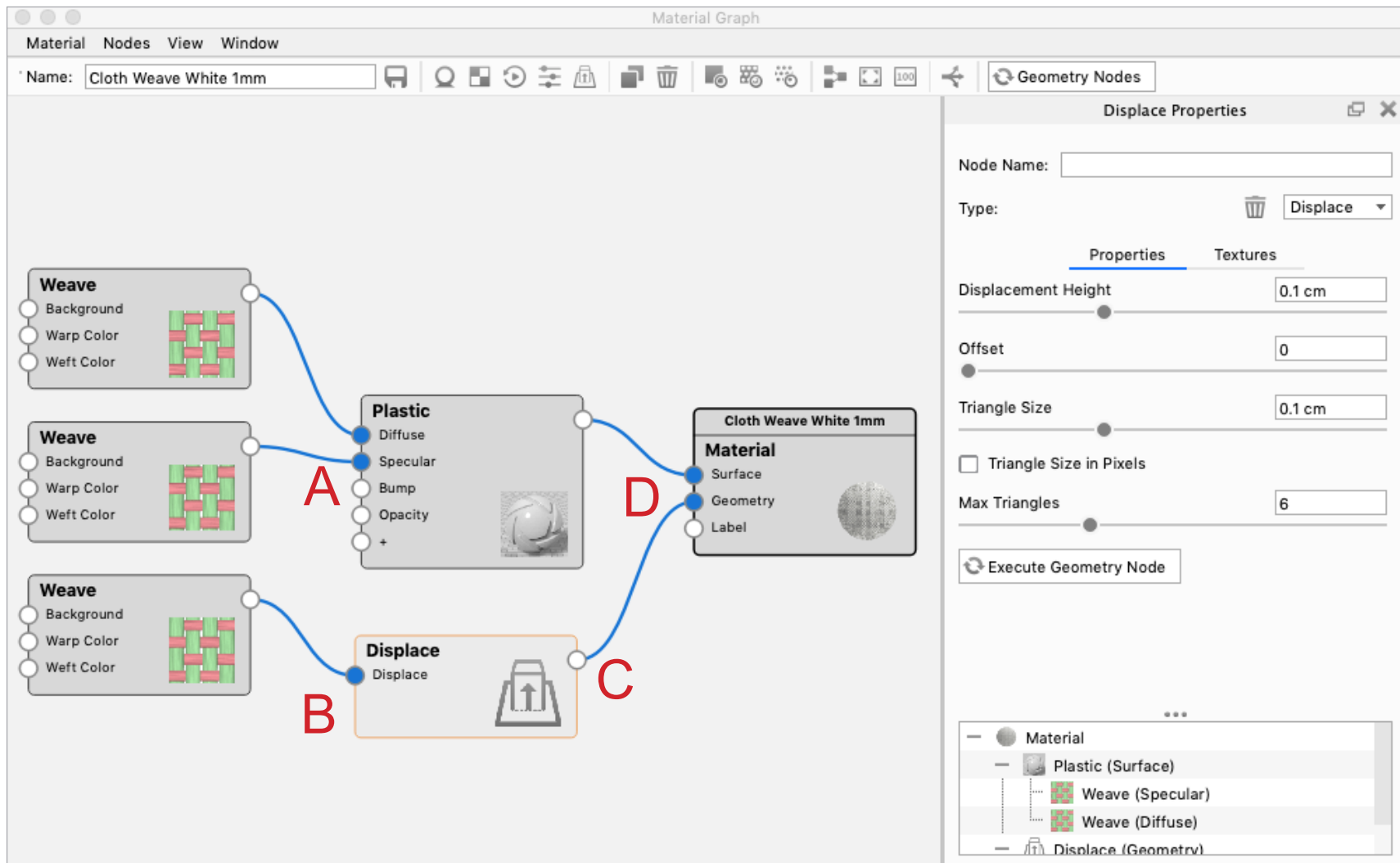
Keyshot - 3D Mapping using Existing Material

Step 4 Next, make the connections between the nodes. Click on the input icon for the bump (A) and drag it to the input for the Displace node. Then, click and drag from the Displace output icon (C) and make a connection to the input icon for the Geometry.



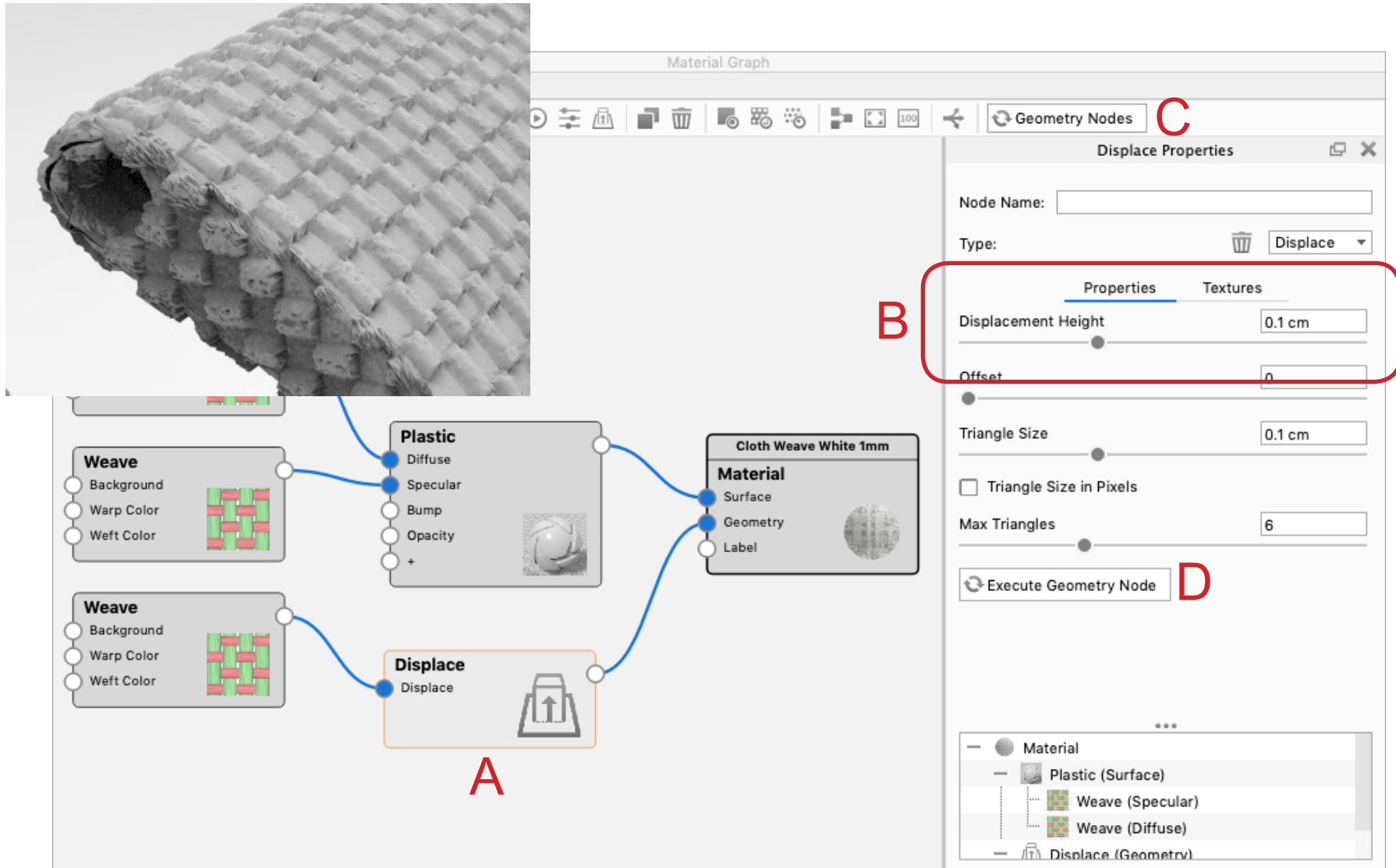
Keyshot - 3D Mapping using Existing Material

Step 4 Next, make the connections between the nodes. Click on the input icon for the bump (A) and drag it to the input for the Displace node (B). Then, click and drag from the Displace output icon (C) and make a connection to the input icon for the Geometry (D).



Keyshot - 3D Mapping using Existing Material

Step 5 Before executing the Geometry Node to visualize the 3D effect, check the Displacement Height value. It is usually set too high and if you did execute the Geometry Node, you will see a black screen because the displacement mapping would fill it. Double clicking on the Displace Node (A), then adjust the Displacement Height value (B) to something that seems more reasonable and then select either the Geometry Node (C) or Execute the Geometry Node buttons (D).



Keyshot - 3D Mapping using Existing Material

Step 6 Continue to adjust the Displacement Height value (A). After each change (make sure to hit Return or Tab) select either the Geometry Node (B) or Execute the Geometry Node buttons (C).

The screenshot displays the KeyShot software interface for 3D mapping. On the left, a 3D model of a woven material is shown. The main area is the 'Material Graph' window, which contains several nodes: 'Weave' (with 'Background', 'Warp Color', and 'Weft Color' settings), 'Plastic' (with 'Diffuse', 'Specular', 'Bump', and 'Opacity' settings), 'Displace' (with a 'Displace' button), and 'Material' (with 'Surface', 'Geometry', and 'Label' settings). A red box labeled 'A' highlights the 'Displacement Height' slider in the 'Displace Properties' panel, which is set to 0.1 cm. A red box labeled 'B' highlights the 'Geometry Nodes' button in the 'Material Graph' window. A red box labeled 'C' highlights the 'Execute Geometry Node' button in the 'Material Graph' window. The 'Displace Properties' panel also shows 'Offset' (0), 'Triangle Size' (0.1 cm), and 'Max Triangles' (6).

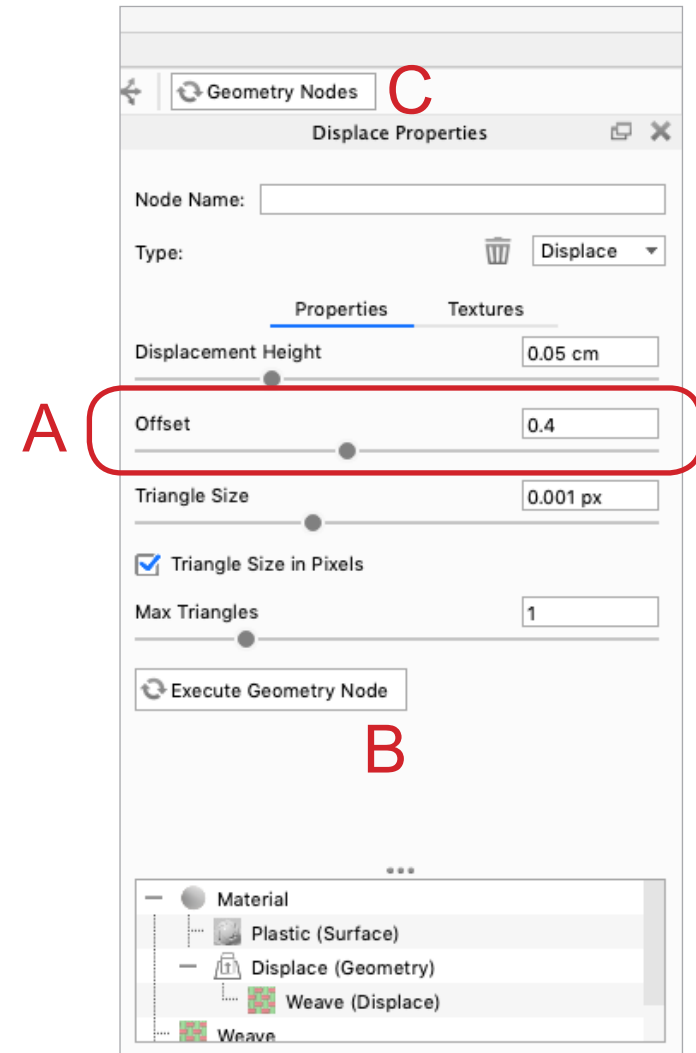
Step 7

Changes to the pattern and the amount of displacement can be made on the texture. Double click on the Weave texture (A) and adjust the color values to change the relative height (B). After each change select either the Geometry Node buttons (C). Interesting, the Bump Height value does not effect the Displacement.



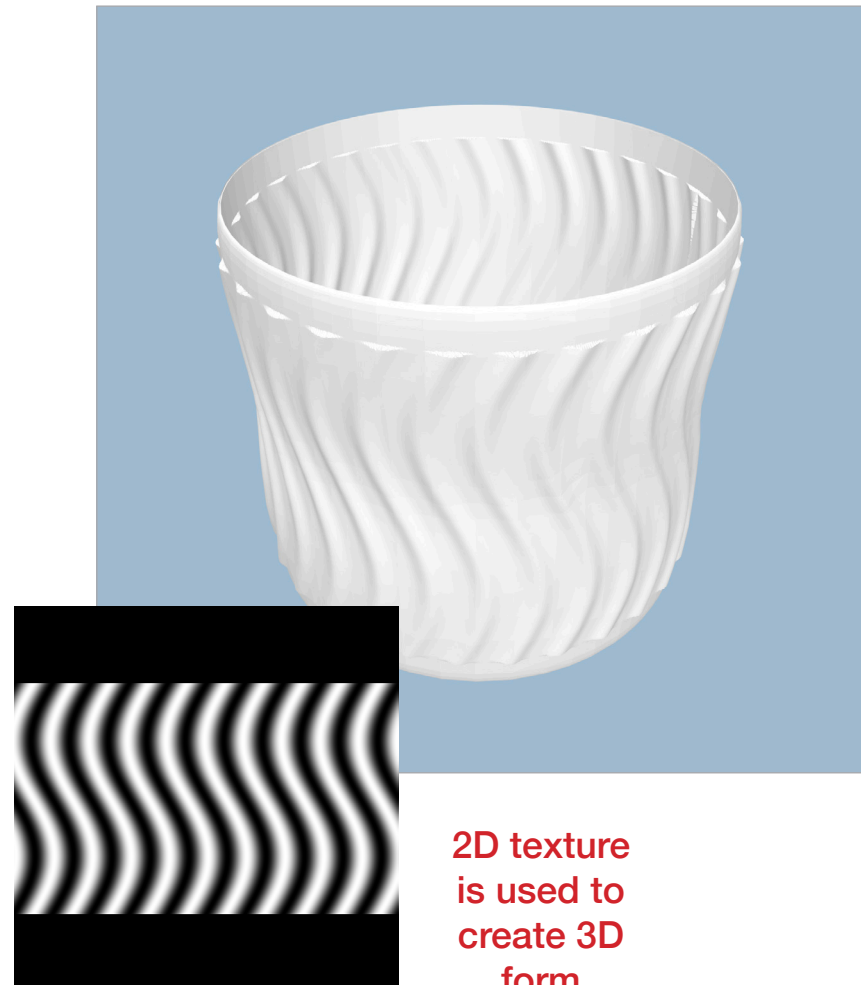
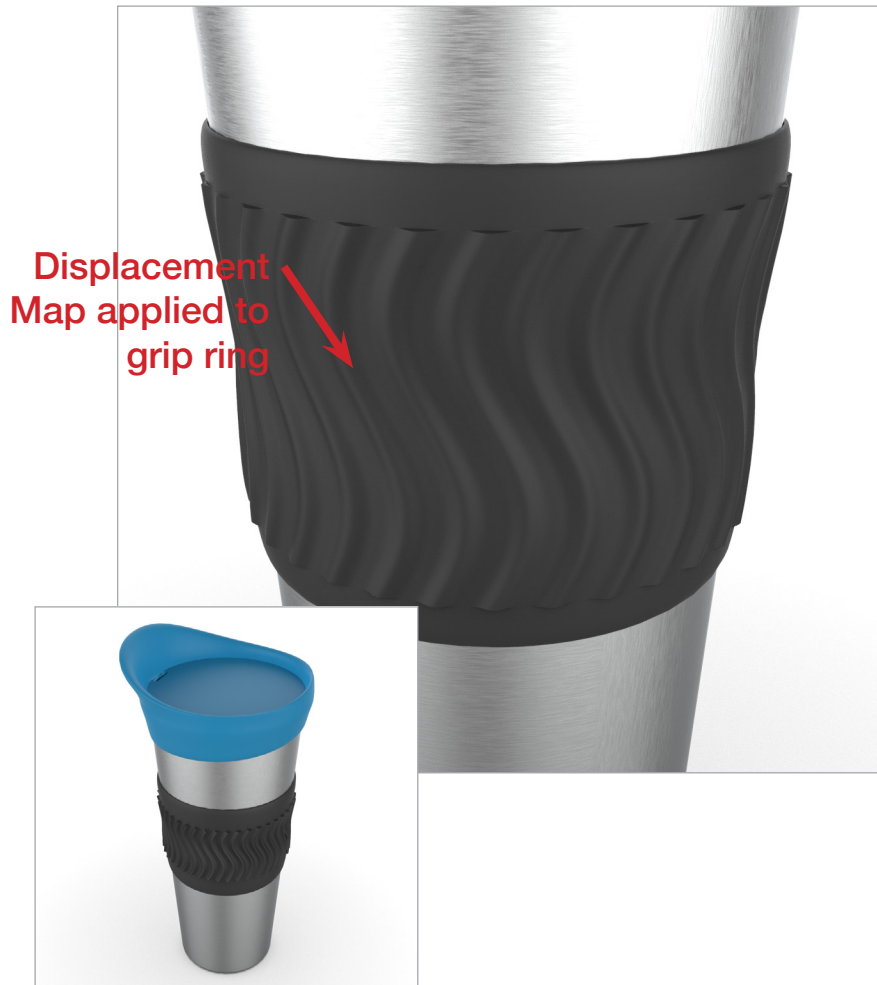
Keyshot - 3D Mapping using Existing Material

Step 8 Displacement mapping makes the form larger since it is pulling the texture from the pattern. Use the Offset value under the Displace node (A) to pull the form back to the original form. A rough guide is that the Offset value should be half the value of the Displacement Height. Offset value is a percentage of the Displacement Height. After each change select either the Geometry Node buttons (C). Interesting, the Bump Height value does not effect the Displacement.



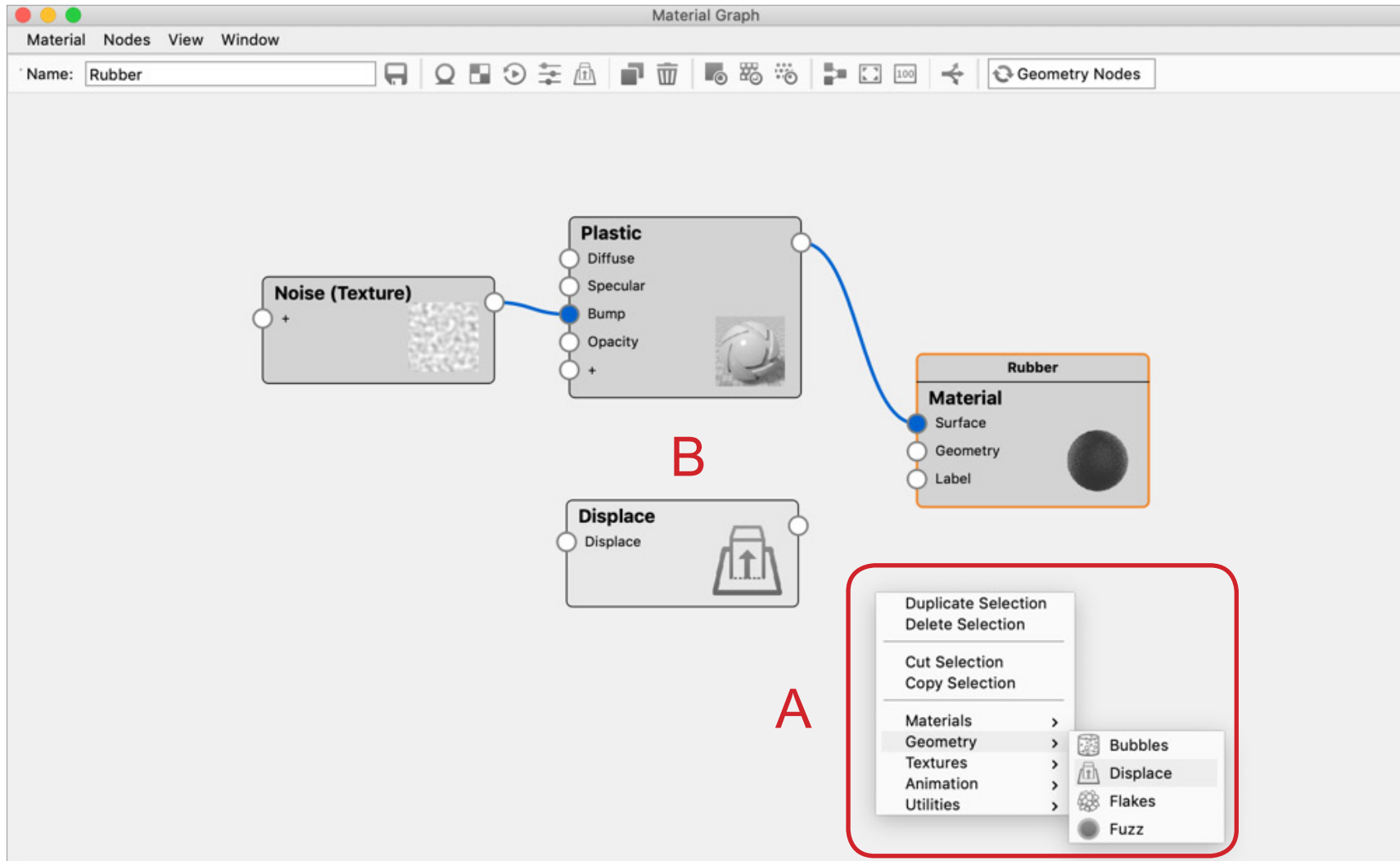
Keyshot - 3D Mapping using Image File

Another method for creating a texture for displacement mapping is to use a 2D image file. In the example below, the 2D image of the curve lines is used as the source to create the pattern on the grip area.



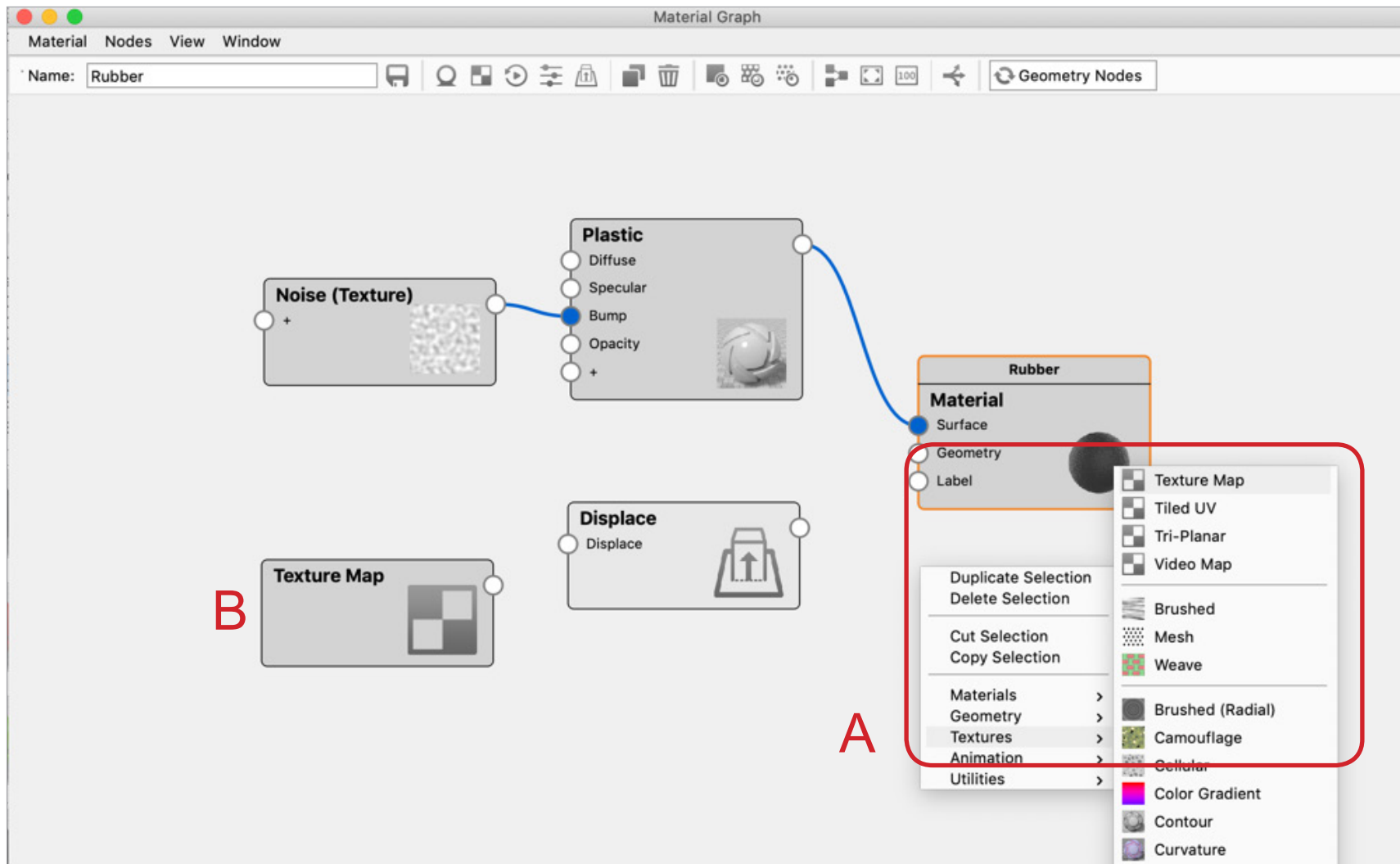
Keyshot - 3D Mapping using Image File

Step 1 Open the Material Graph window from the Material panel. The graphs elements in the window are know as “nodes”. A new node needs to be added for the Displace Mapping. Right mouse click in the open area and select Geometry > Displace (A). Drag the Displace node below the material Type node (B).



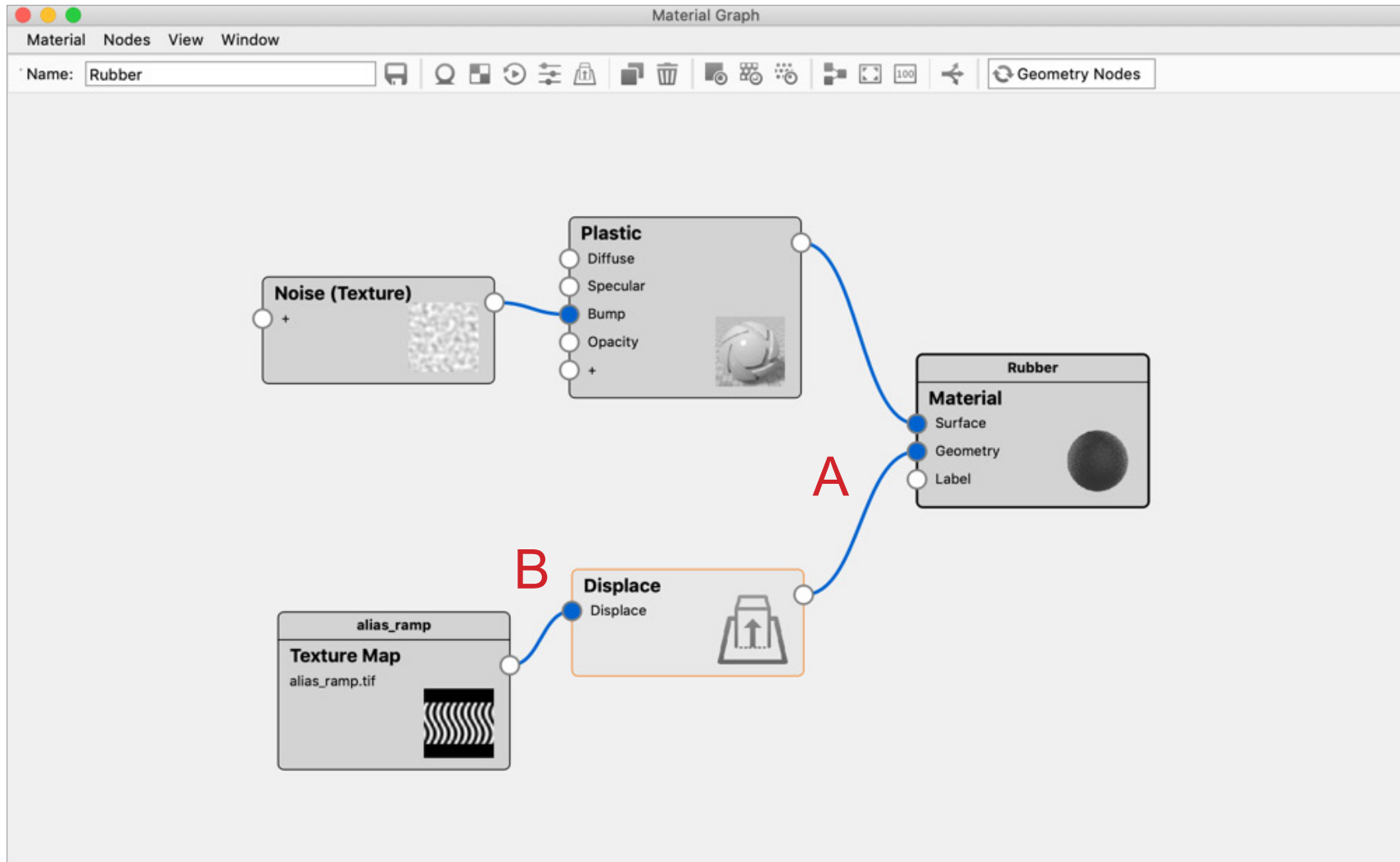
Keyshot - 3D Mapping using Image File

Step 2 A texture Map node needs to be added so a image texture can be used. Right mouse click in the open area and select Texture > Texture Map (A). Drag the Texture node to the left of the Displace node (B).



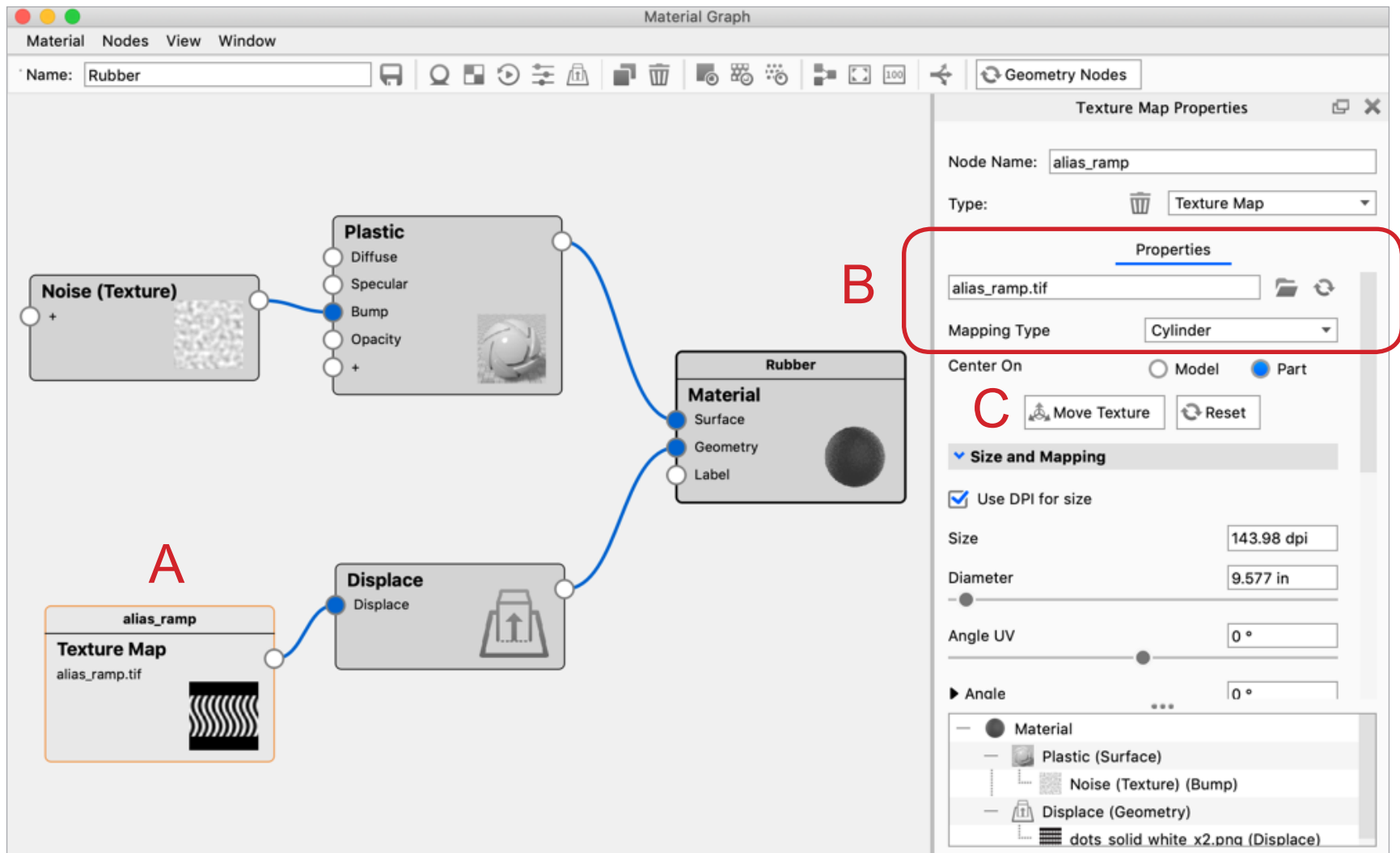
Keyshot - 3D Mapping using Image File

Step 3 Next, make the connections between the two new nodes. Click and drag on the Displace output icon and connect it to the Geometry input icon (A). Then, click and drag on the Texture Map output icon and connect it to the Displace input icon (B).



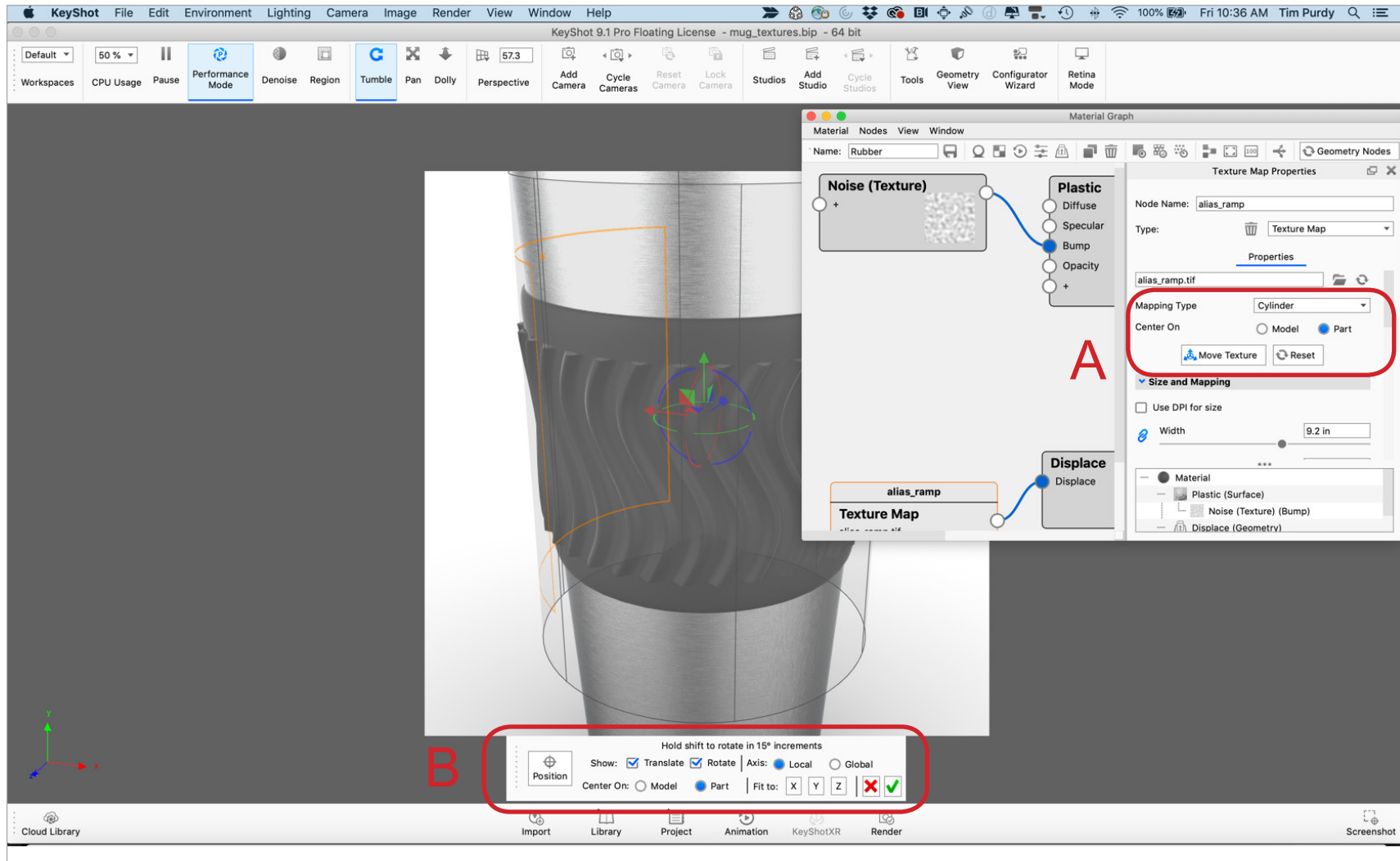
Keyshot - 3D Mapping using Image File

Step 4 Double click on the Texture Map node (A). Select the Folder icon next to the texture input box (B) and select the texture.



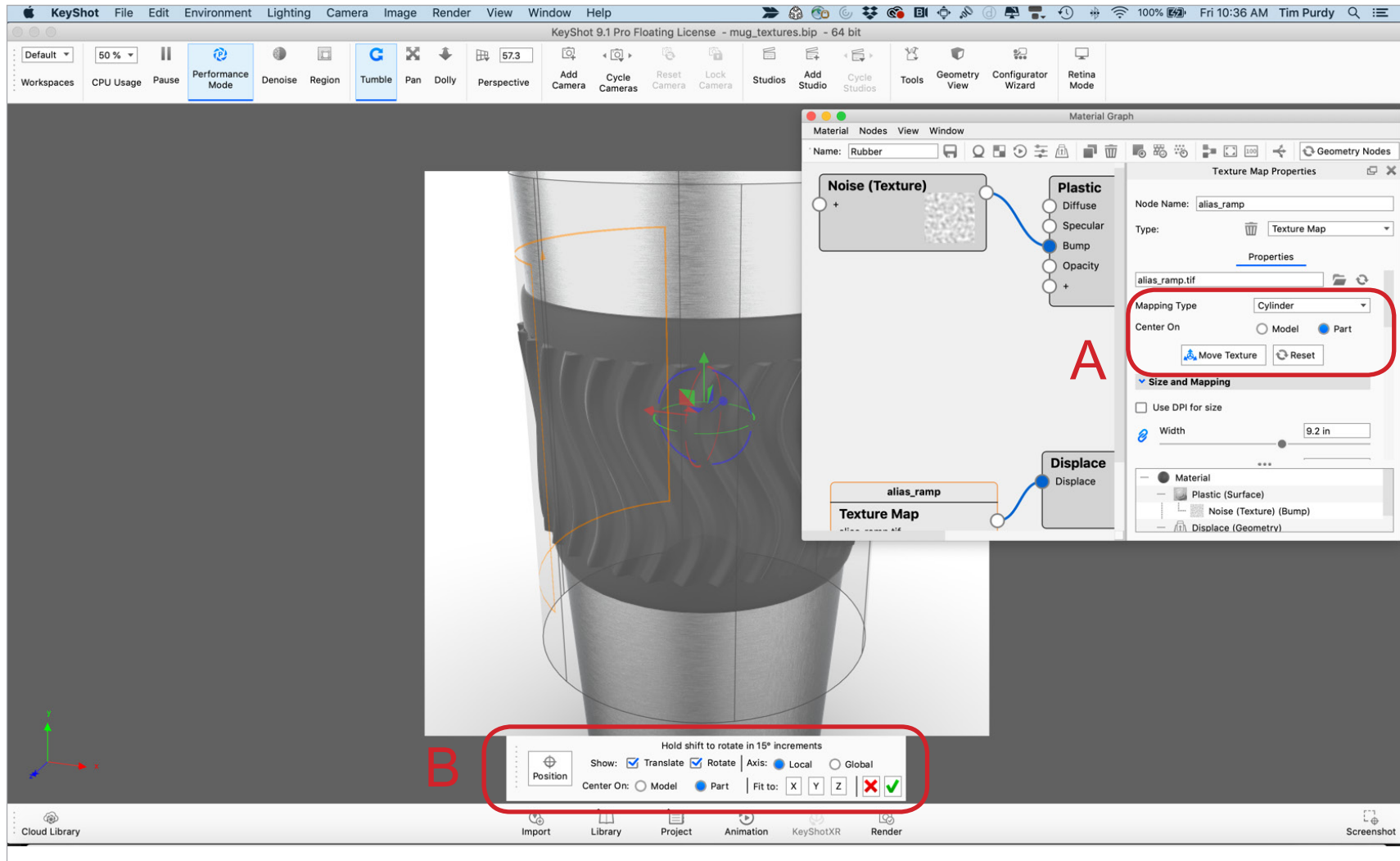
Keyshot - 3D Mapping using Image File

Step 5 Depending on the 3D form, the Mapping Type may need to be changed. In this case, it was switched from box to cylinder (A). Select the Move Texture button to edit the location, orientation and size of the texture icon (B).



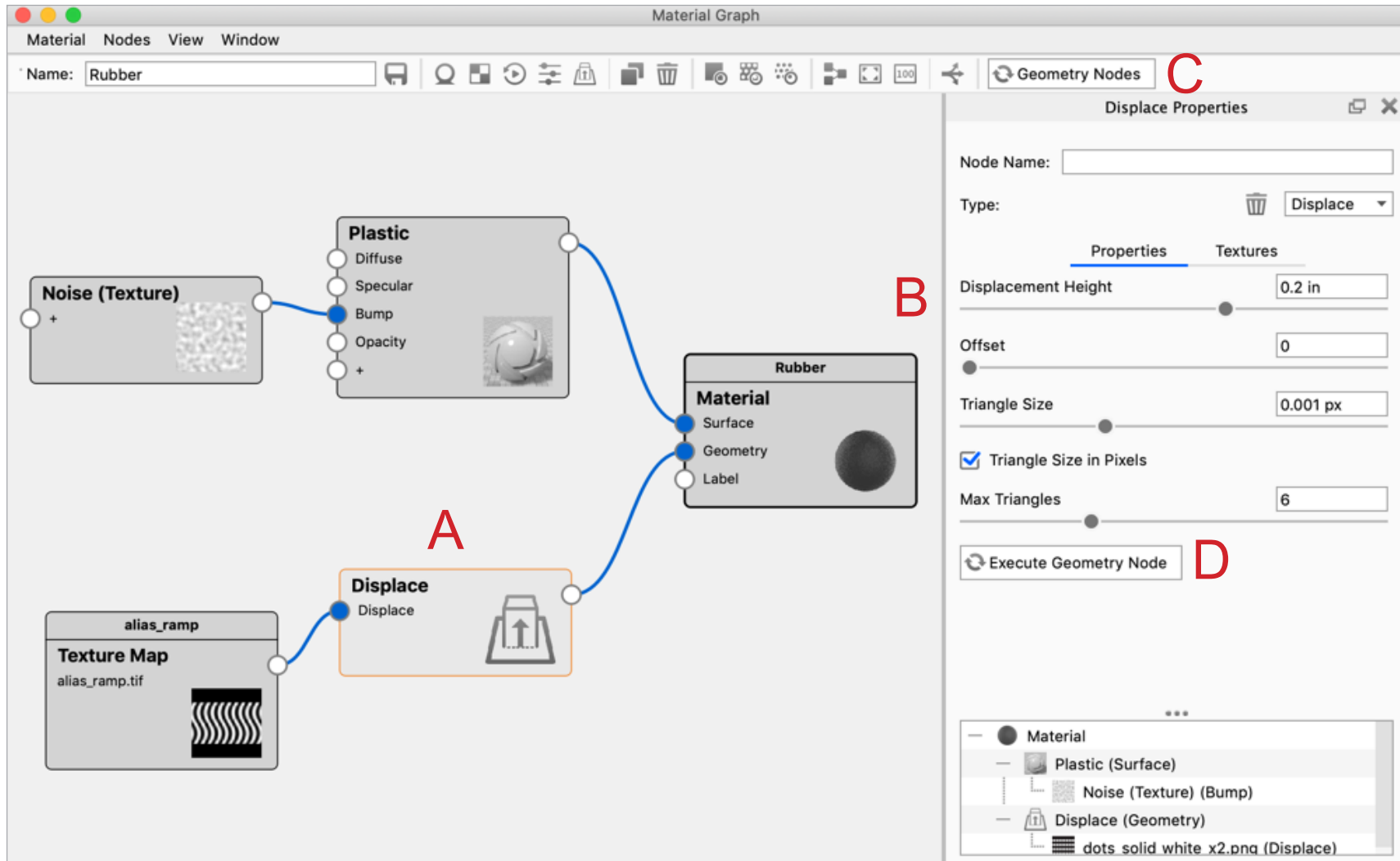
Keyshot - 3D Mapping using Image File

Step 6 Depending on the 3D form, the Mapping Type may need to be changed. In this case, it was switched from box to cylinder (A). Select the Move Texture button to edit the location, orientation and size of the texture icon (B).



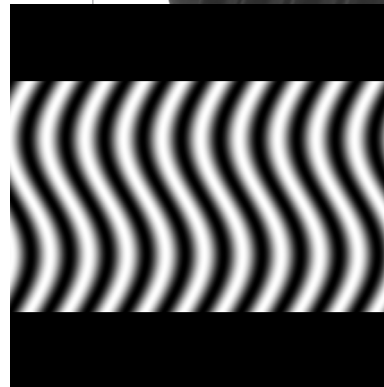
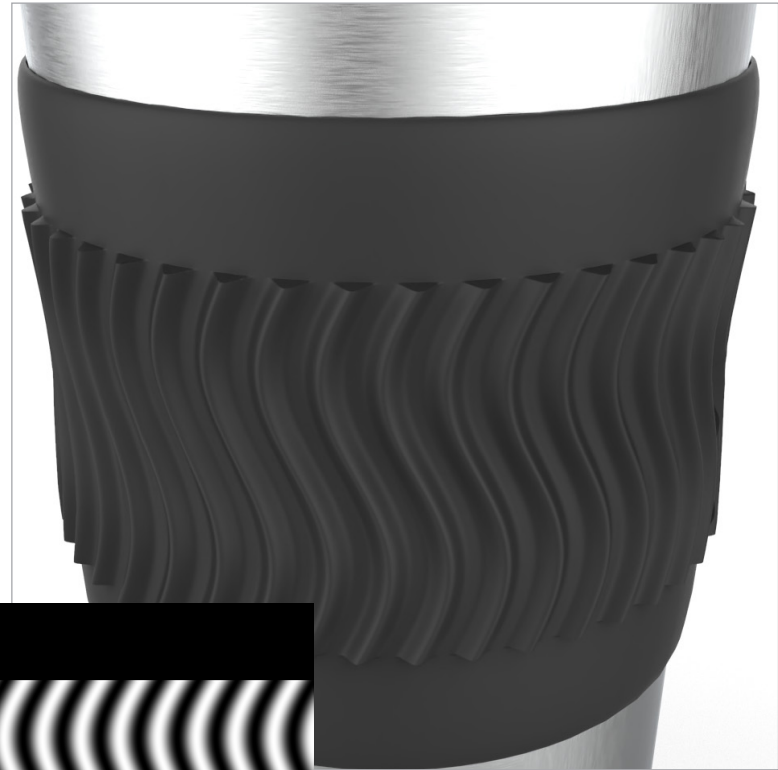
Keyshot - 3D Mapping using Image File

Step 7 Before executing the Geometry Node to visualize the 3D effect, check the Displacement Height value. Double clicking on the Displace Node (A), then adjust the Displacement Height value (B) to something that seems more reasonable and then select either the Geometry Node (C) or Execute the Geometry Node buttons (D).



Keyshot - 3D Mapping using Image File

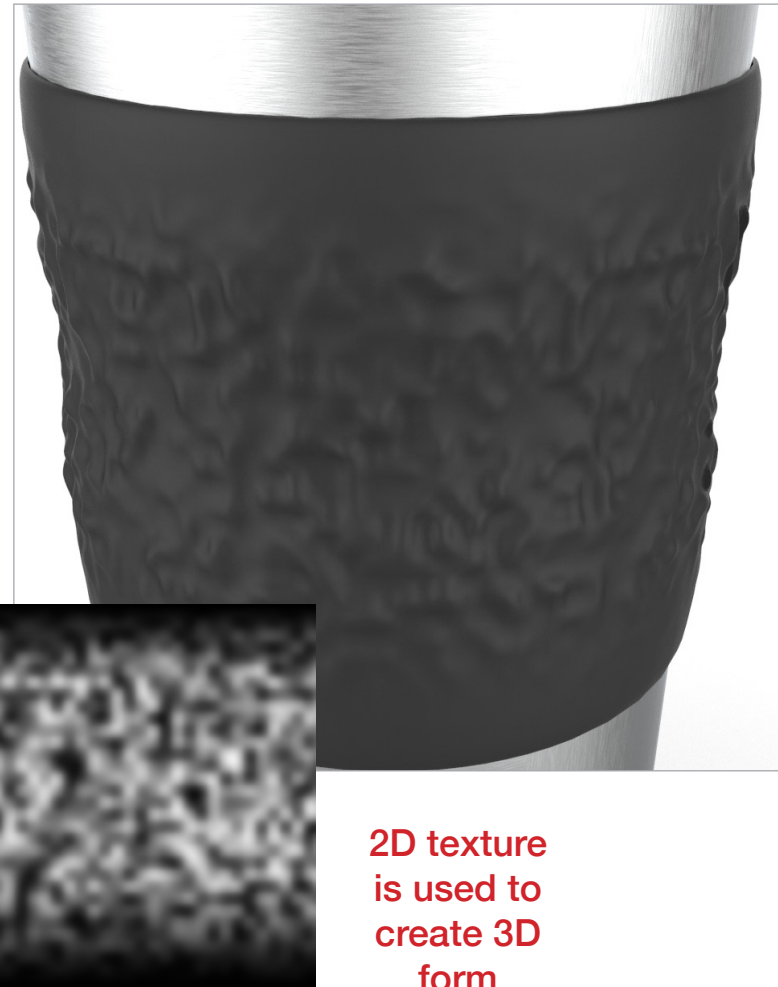
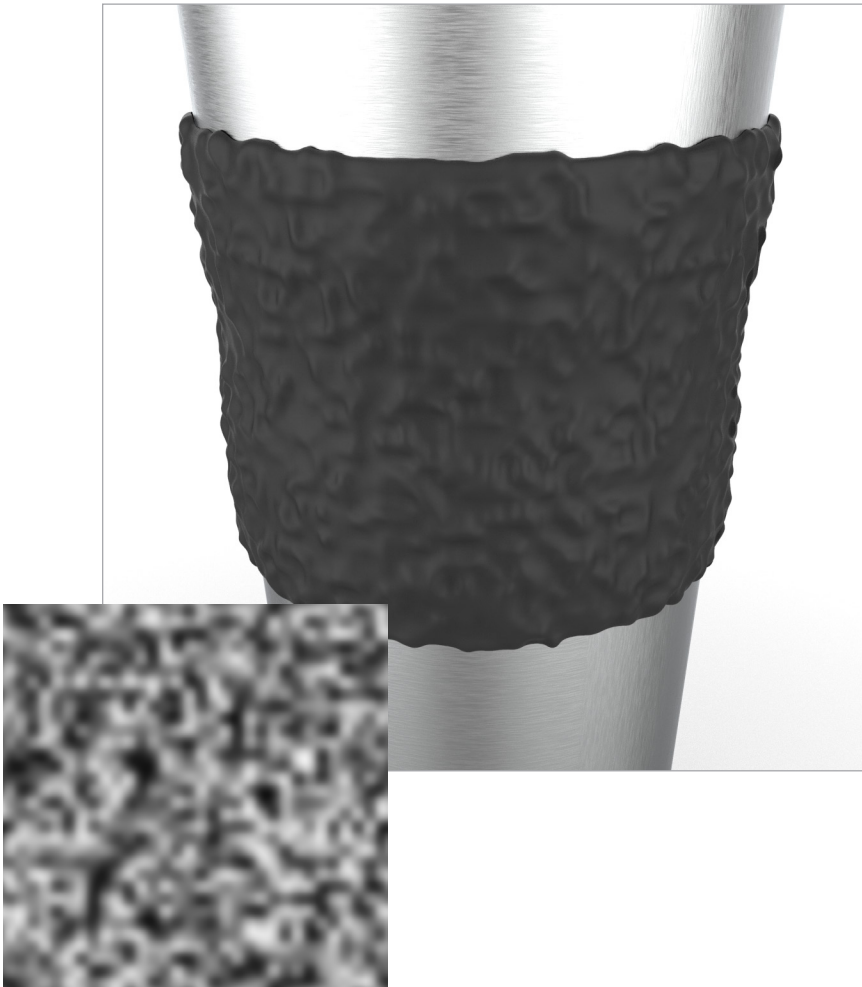
By adjusting the size and location of the texture and/or the Displace height, a variety of patterns can be made.



2D texture
is used to
create 3D
form

Keyshot - 3D Mapping using Image File

These images demonstrate the use of a fractal pattern as the texture source. The images on the left show how the form is displaced on the top and bottom since the fractal pattern touches the images of the texture source. The images of the right use a fractal pattern that has a gradient applied to the top & bottom. Therefore, the displacement fades away in the 3D model and does not displace the edges.



**2D texture
is used to
create 3D
form**

Keyshot - 3D Mapping using Image File

This example shows a dot pattern applied as a 2D texture source. The Displacement Height is different between the two images.

Displacement Height: .1
Offset: 0



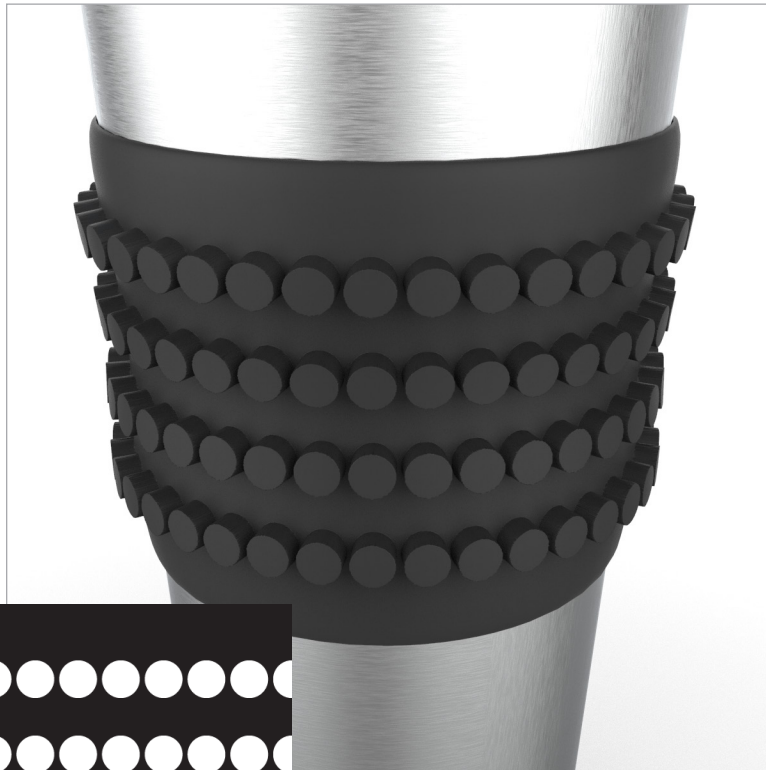
Displacement Height: .2
Offset: 1



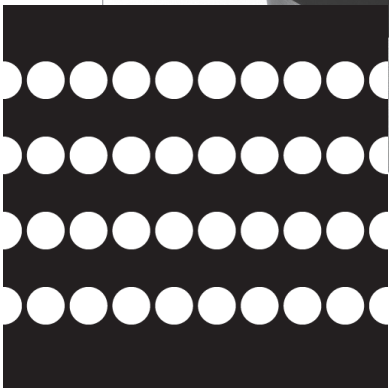
Keyshot - 3D Mapping using Image File

These images show how the 3D texture can be further displaced or even reserved by adjusting the Displacement Height and the Offset value.

Displacement Height: .4
Offset: 0



Displacement Height: -.2
Offset: 1



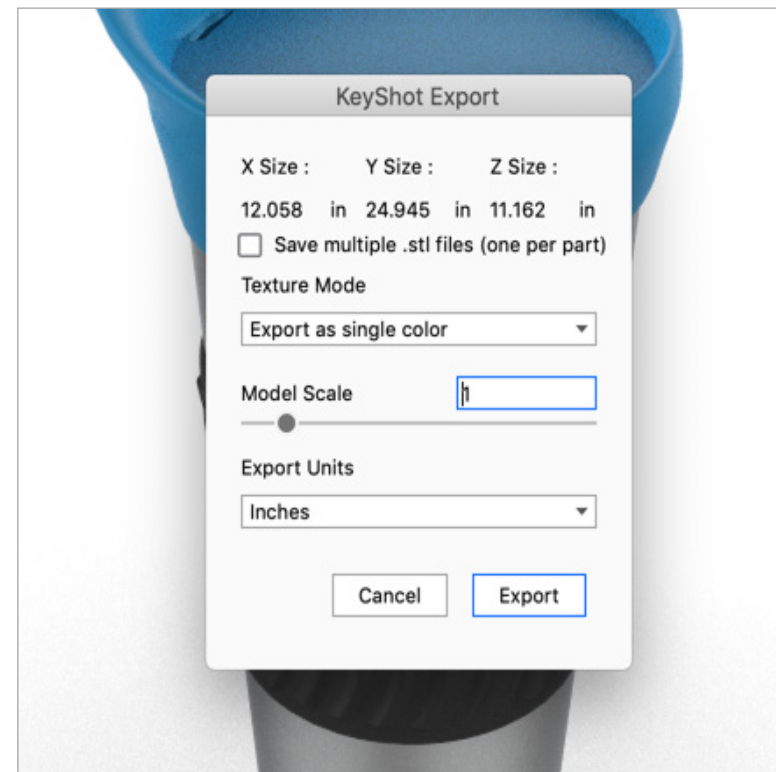
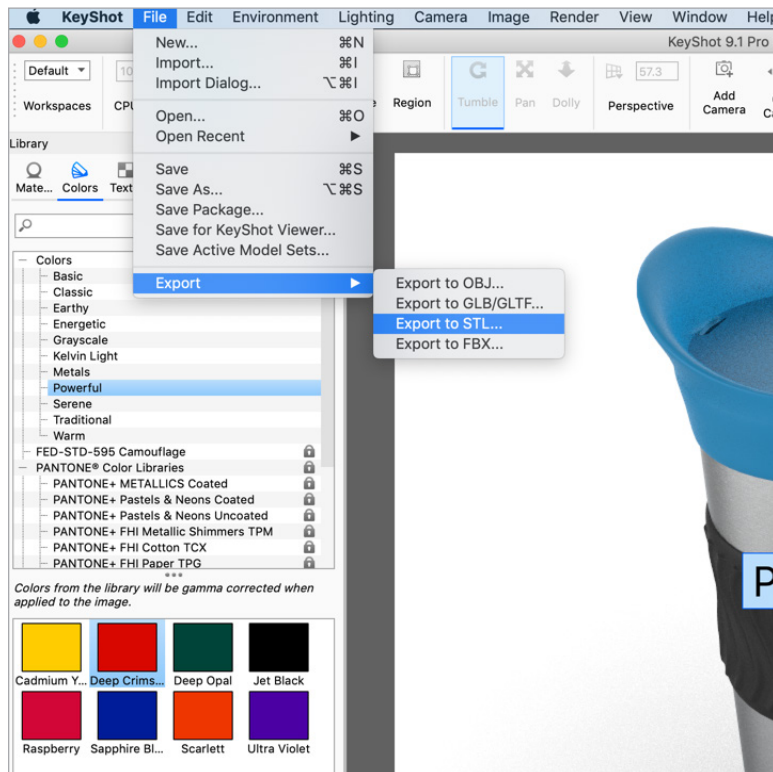
Keyshot - 3D Mapping using Image File

A logo image can also be used to make the pattern. The white elements would be the highest value, grey elements are in between and black elements do not move.



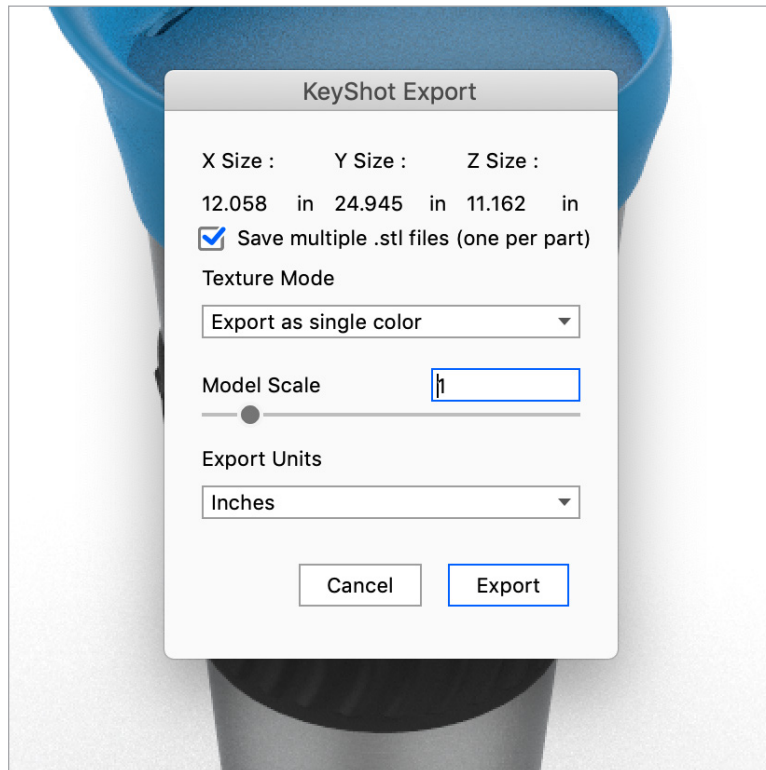
Keyshot - Printing 3D Mapping

To create the STL output, go to File > Export > Export to STL. Verify the size, scale and export units.



Keyshot - Printing 3D Mapping

The STL output can be saved as multiply files for easier printing. The size of an STL file with a texture can be rather large. In the image on the right side, both a single stl file option (A) and the “saved as multiply files” (B) are shown. Notice that the file with the 3D textures (mug_output.stl and mug_texture2.stl) are around 90 megabytes in size. Printing files with 3D textures can take longer to print because of the processing and printing time from the larger file size.



A

B

Name	Date Modified	Size
mug_output.stl	10:22 AM	90.8 MB
mug_texture1.stl	4/9/20	307 KB
mug_texture2.stl	4/9/20	90.3 MB
mug_texture3.stl	4/9/20	142 KB