Bandicoot Imaging Sciences

Fundamentals of Tiling

User Manual for the Bandicoot Tiling Editor

Fabric Digitisation Skills

In this guide, you will learn how to tile a digital fabric with Bandicoot

You will learn

1. Overview of tiling with Bandicoot
2. Basic commands for navigating the tiling editor
3. How to inspect the quality of a tiled material
4. All about automatic tiling
5. How to do manual tiling, including how to
   a. manually set a suitable tiling region
   b. use control points to improve seams
6. How flattening reduces variation across a tile

Advanced techniques will be covered in a future Advanced Tiling Guide.

FABRIC TYPES	TECHNIQUE	SKILL LEVEL
Plain matte fabric (e.g. woven cotton, poly, linen or denim)	9 shot scan	Beginner
All	Fabric preparation	Intermediate
Textured (e.g. Jacquard) Glossy (e.g. satin) Metallic and foil Velvet Leather	25 shot scan	Intermediate
Pattern repeats up to 40 cm	**Tiling**	Intermediate
Lace and sheers	Alpha scan	Advanced
Pattern repeats between 40 cm and 1 m	Large scans	Advanced
Pattern repeats above 1 m	Stitching multiple scans	Advanced

Tiling with Bandicoot - Introduction

High quality tiling is crucial to 3D design

When a digital fabric is applied to a 3D model, it's often repeated across the model. Tiling a digital fabric means seamlessly repeating the fabric in all directions to create an ‘infinite’ digital fabric.

This repetition must be visually flawless to avoid noticeable repeats.

Seamless tiling ensures the lighting and material properties transition smoothly across the surface, resulting in a realistic and believable final render of a digital fabric.

A single tile

A single tile seamlessly repeated in multiple directions

Tiling with Bandicoot - Overview

Bandicoot automatically tiles your scanned and imported materials. For many materials, Bandicoot's automatic tiling gives high quality results that can be used on a 3D model right away.

Tiling is a complex process. Sometimes an automatic tiling result does not pass a quality check.

Bandicoot's **tiling editor** is a tool for:

- **Verifying the quality** of automatic tiling
- Where needed, **correcting the tiling** with simple but powerful controls

Tiling with Bandicoot - Challenges

Tiling is a complex process

Many issues need careful consideration when creating a seamless tile, whether automatically or manually. These include:

- The weave or stitching needs to join up across the seam.
- If the weave or stitching is loose, then weave or stitch lines might be slightly curved when scanned, and that needs to be straightened out to create a seamless tile.
- If there is a pattern repeat, at least one whole pattern needs to fit inside the tile, and the pattern needs to join up across the seam.
- If the fabric has a lot of natural variation, then the tile needs to be large enough to capture that natural variation so that the digital fabric on the garment doesn't look too uniform or obviously repetitive.
- The scan may have changes in brightness or texture that need to be evened out so that the tiles are not visible when the tile is repeated across the garment.
- There may be blemishes in the scan that need to be avoided when creating a tile.

Tiling with Bandicoot - Techniques

The Tiling Editor performs several techniques for creating a seamless tile

These include:

- **Automatically detecting the yarn** to straighten curves in the yarn and to join the weave or stitch across the seams.
  - This uses a Bandicoot technology called **WeaveLock** to detect the yarn.

- **Automatically detecting pattern repeats.**
  - This uses a Bandicoot technology called **WeaveSearch** to detect repeat patterns in the digital fabric.
  - The tile will contain a whole number of repeats so that the repeat always joins up across the tile seams.

- **Manual tiling**, which is useful when WeaveLock cannot detect the weave of a fabric. The Tiling Editor has a manual tiling mode which allows you to manually set:
  - Tile corners to match the repeat pattern; and
  - Pairs of control points on matching features on either side of the tile to improve matching pattern repeat on the seam.

- **Automatic flattening**, which reduces variation and creates an even appearance for the repeated tile.
  - **Tile flatten** automatically matches the contrast and colour across the tile seams.
  - **Extra flattening** can be fine tuned for additional flattening to reduce variation inside the tile.

Tiling with Bandicoot - WeaveLock

WeaveLock is a new technology invented by Bandicoot

WeaveLock is a Bandicoot technology for automating tiling. To achieve a seamless tile, the weave or stitch needs to join up across the seam.

WeaveLock analyses the digital fabric at the yarn level to match the weave or stitch on all sides, straighten up curving yarn, and generate a tile with invisible seams.

Fig. 1 shows a tiled digital fabric where there is a clear mismatch across the tile seam. This would usually require an expert texture artist to fix.

Fig. 2 shows the same fabric, but this time with WeaveLock. WeaveLock has automatically detected the weave and ensured the yarn aligns seamlessly on all sides.

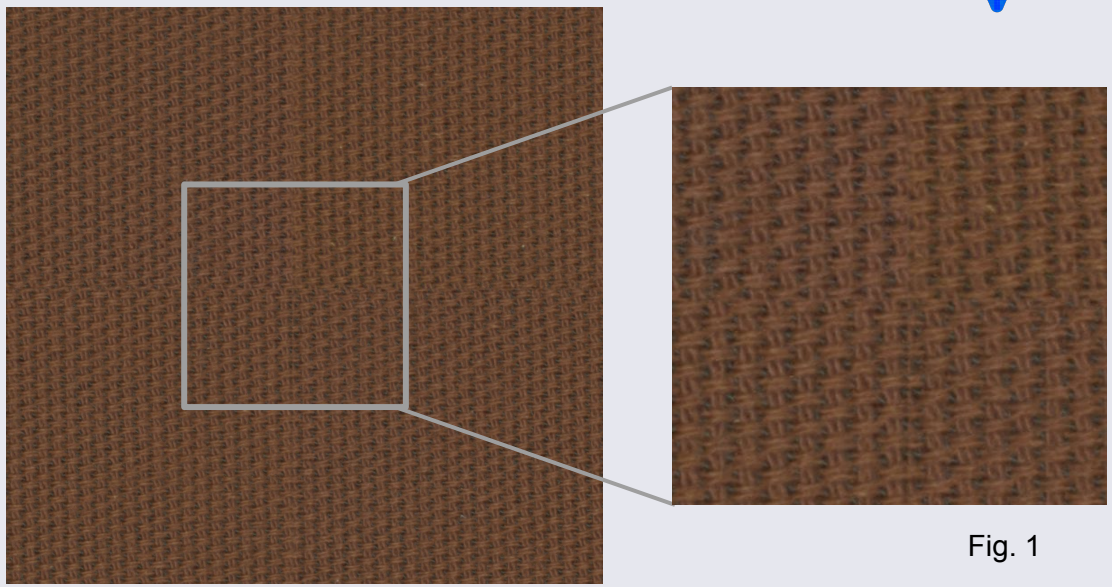


Fig. 1

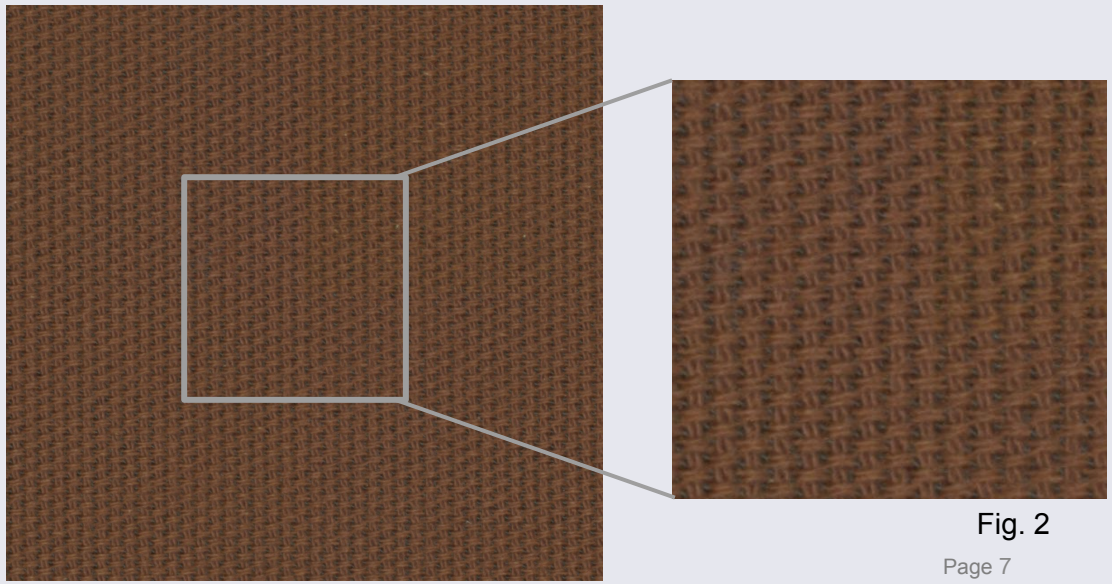
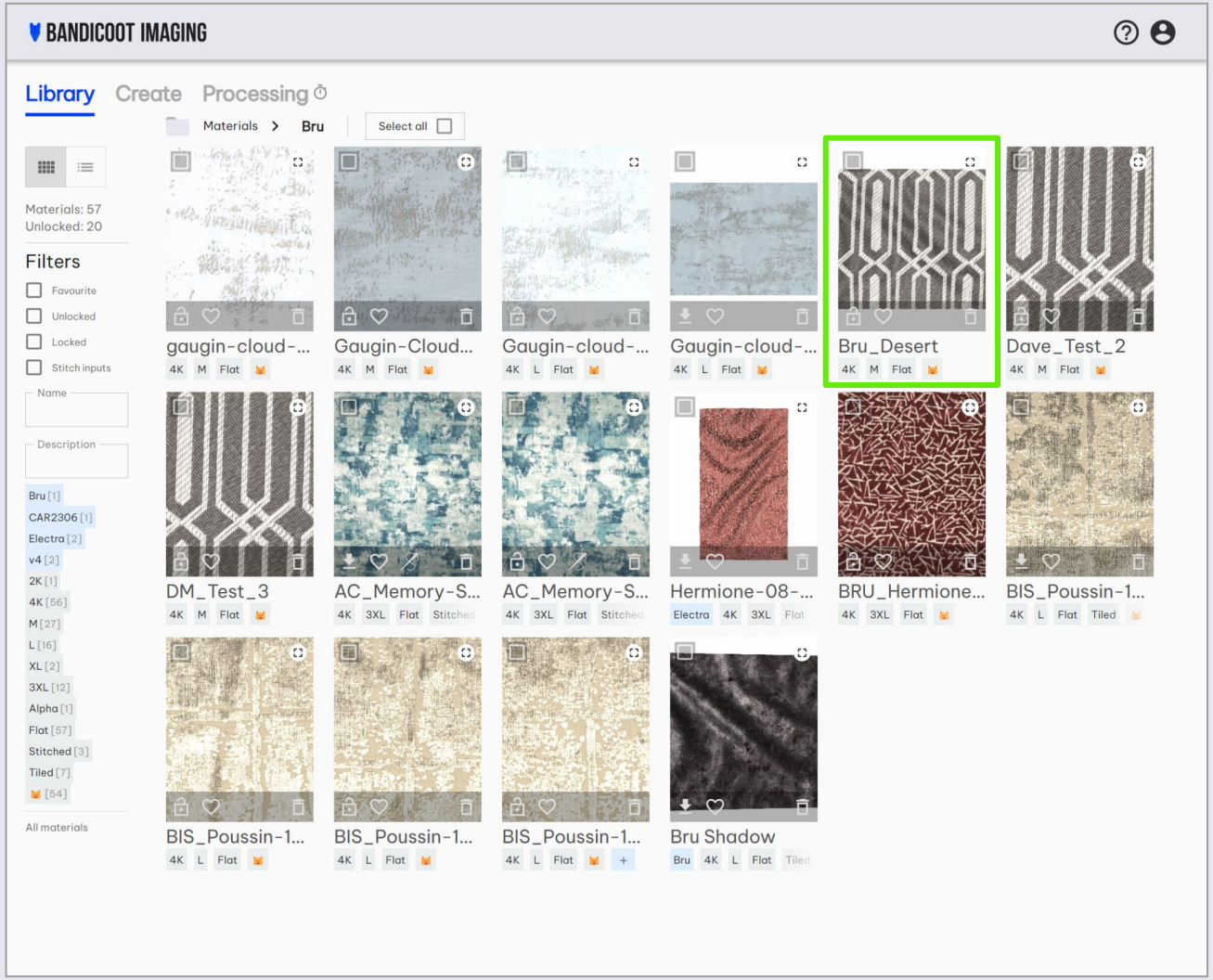


Fig. 2

Navigating the Tiling Editor

Let’s take a look at launching the Tiling Editor

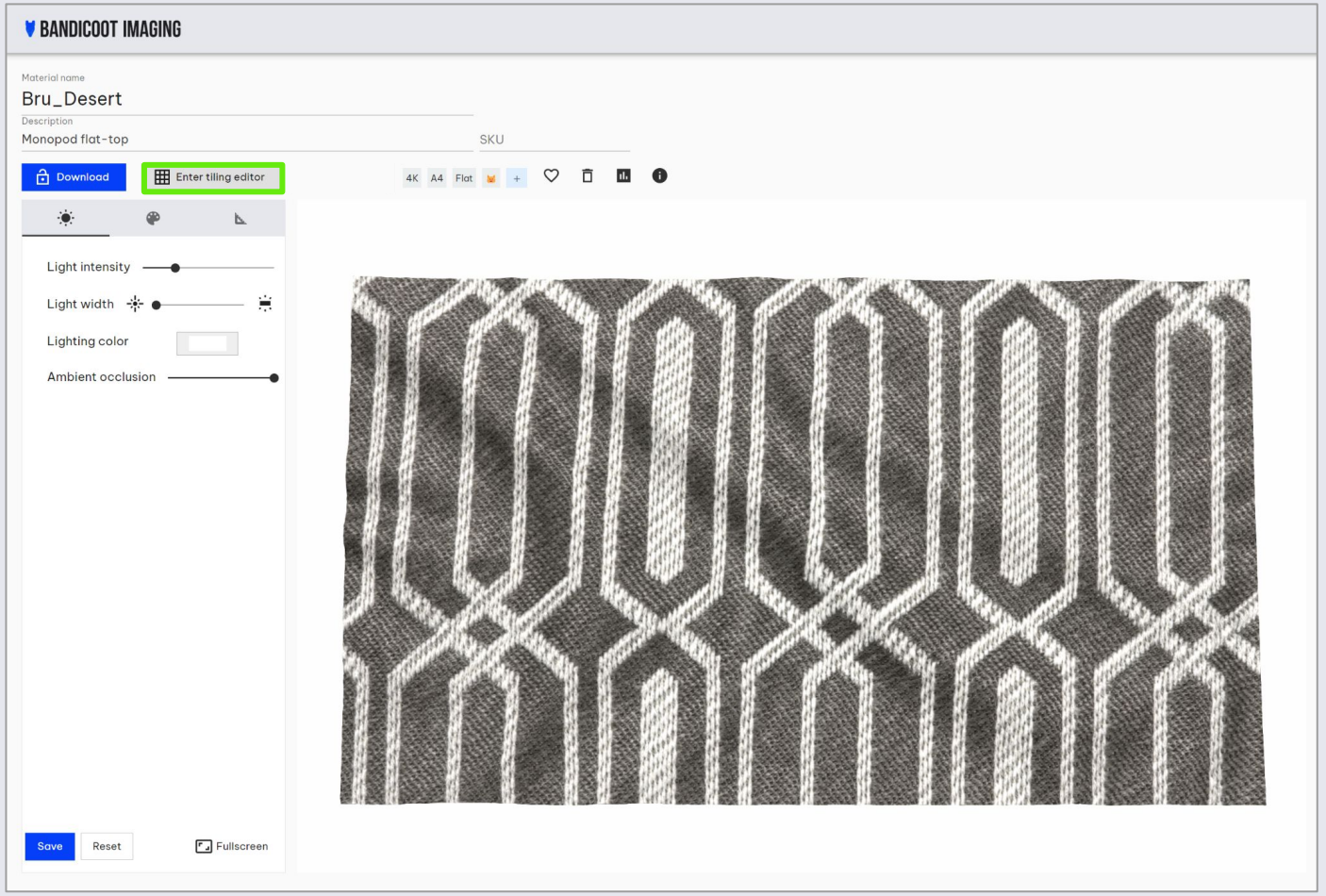
First, in the main library view, click on the material that you would like to tile. This will open the material viewer.



Navigating the Tiling Editor - Launching

Now let’s launch the Tiling Editor

The Tiling Editor is accessed through the ‘Enter tiling editor’ button located in the material viewer window.



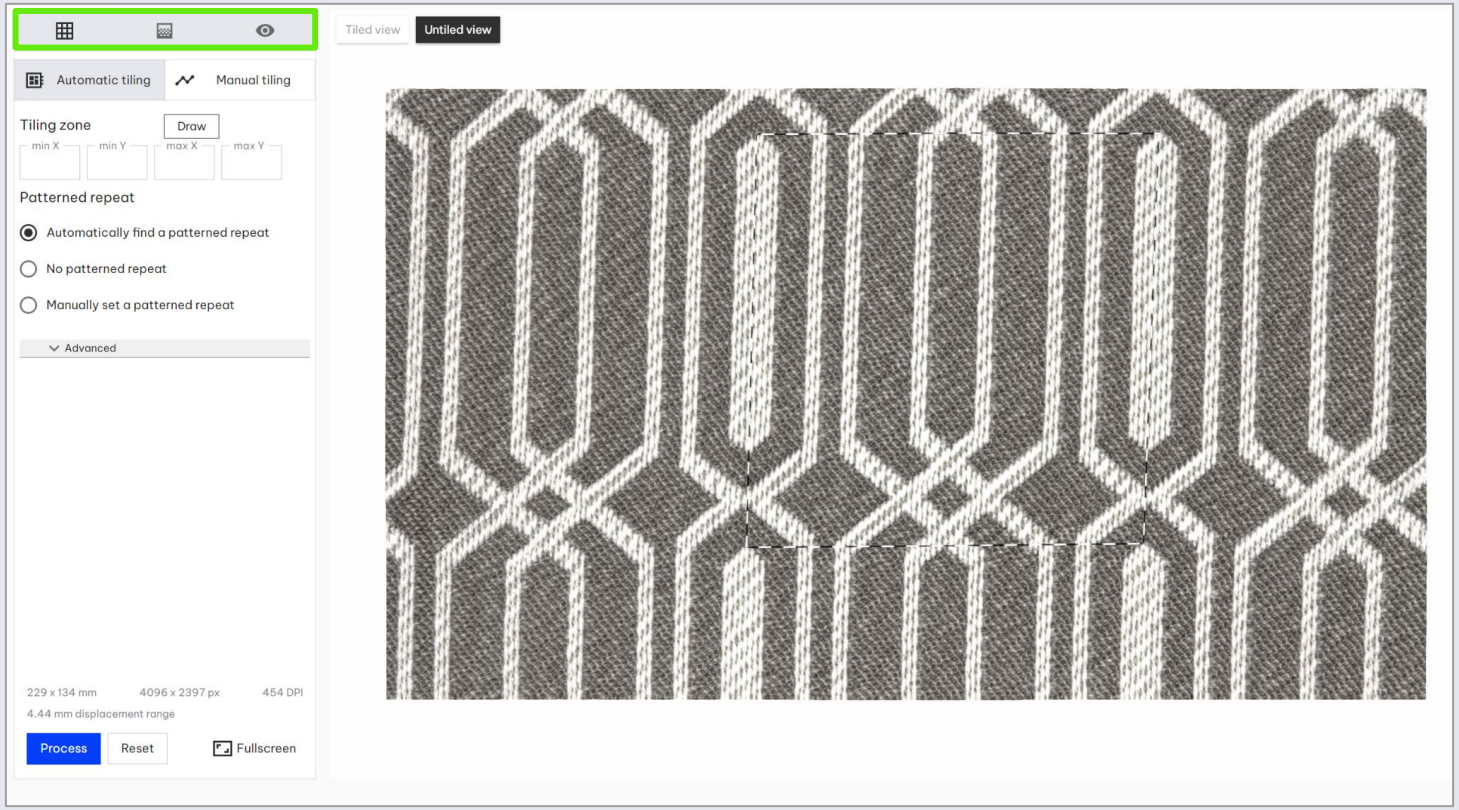
Navigating the Tiling Editor - Main tabs

The three main Tiling Editor tabs are accessed by clicking on the icons

Tiling Boundaries tab: Controls for setting the region to be tiled, automatically or manually.

Flattening and Blending tab: Controls for flattening a tile and reducing variation in the texture files that make up the digital fabric.

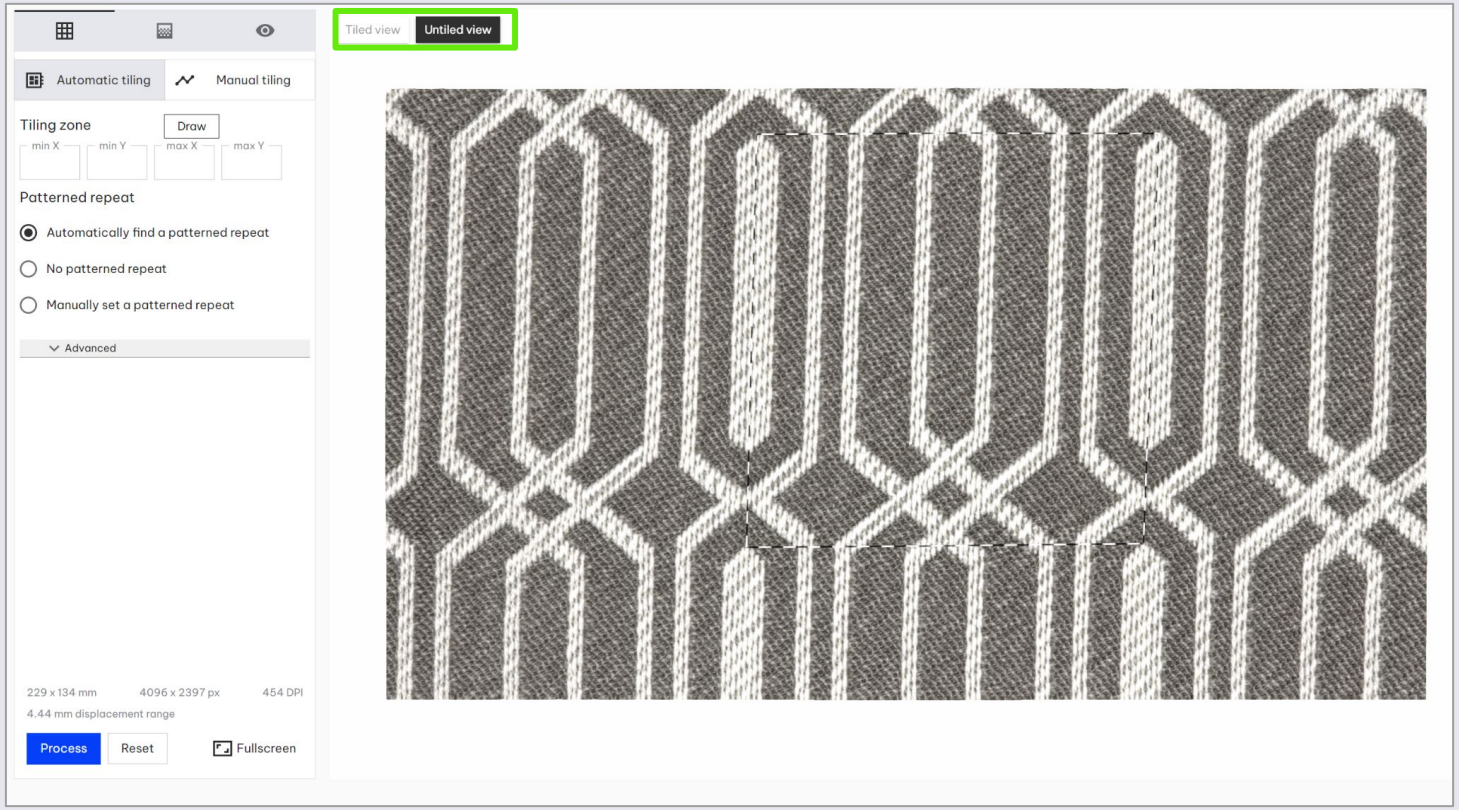
Visualisation tab: Controls for viewing tiling in different texture maps as well as toggles for viewing the tile seam grid.



Navigating the Tiling Editor - Material views

These buttons toggle the viewer between ‘tiled’ and ‘untiled’ views

The black background indicates which view is active.



Untiled view

Untiled view shows the whole untiled area of a digital fabric. This view is used to inspect and set tiling regions.

Tiled view

Tiled view shows the most recent tiling result. This view is used to inspect seams and variations across tiles and tile boundaries.

Navigating - Info & Processing

The bottom of the panel displays information about the material

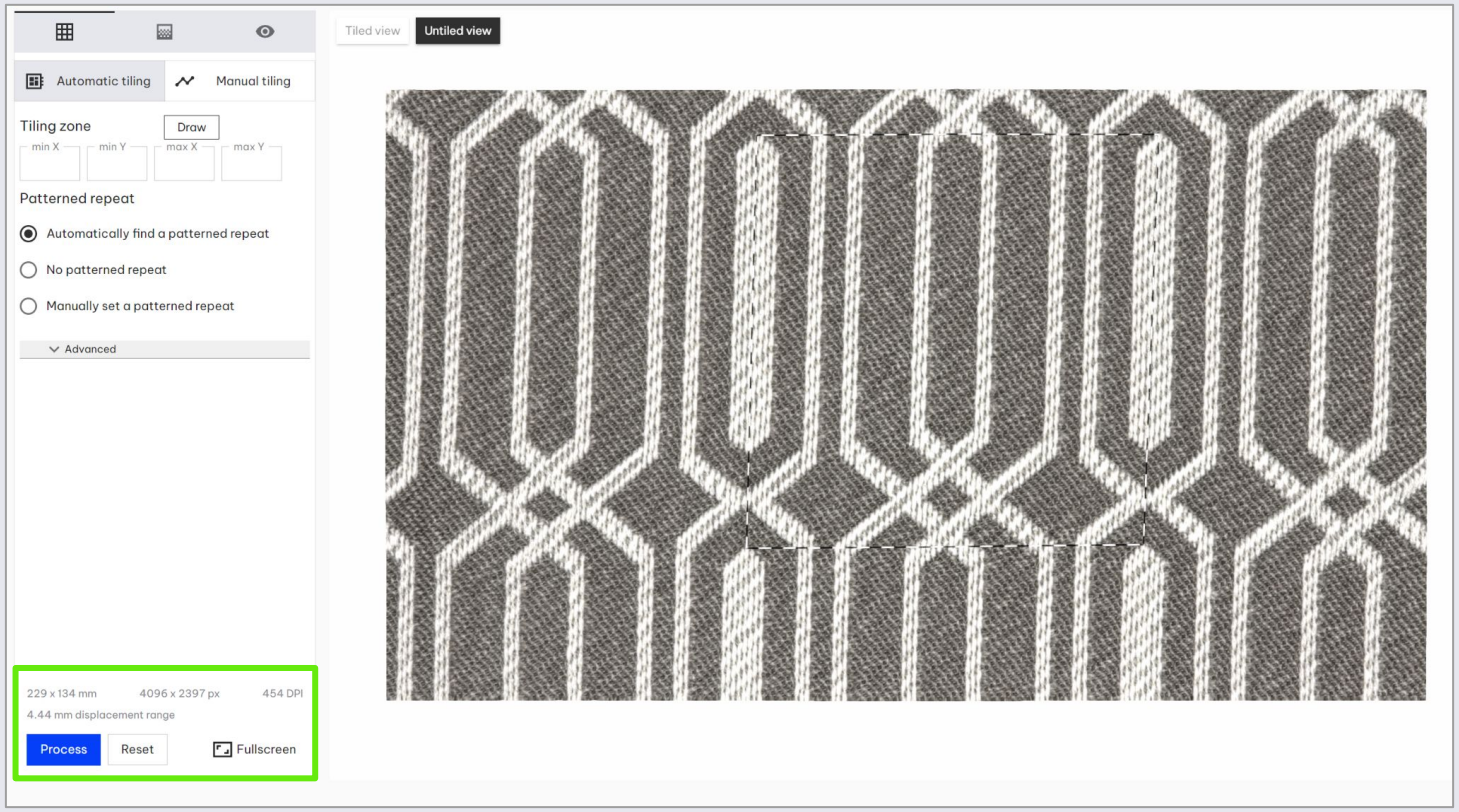
The size of the textures is given in millimetres and pixels. This display updates when you switch between Tiled and Untiled view. The DPI is also shown.

This region of the panel also contains the following buttons:

Process — After changing tiling settings, clicking 'Process' generates the new tiled material. This usually takes 1-2 minutes.

Reset — Reset the tiling settings to the last processed or saved values.

Fullscreen — Toggle into full screen mode. Useful for inspecting seams and variations across the tile.



Inspecting Tiling

Inspecting the tiling results

It is necessary to inspect the results of any tiling to ensure that a satisfactory result has been achieved.

The tiling editor provides a set of tools to inspect the tiling result:

1. Toggle into **Fullscreen** View (F key). The gridlines indicate the tiled region detected by auto tiling. Referring to Fig 1, the pattern repeat has been detected.

2. **Zoom in** (mouse wheel) and **pan** (right-mouse-button drag) to examine the seams more closely, and toggle the **seam lines** on and off (S key). Referring to Fig 2, weavelock has detected the weave and the created seamless tile boundaries (as indicated by arrows).

3. Change the **tiling scale** using the = (equal) and - (minus) keys to examine the tiling at different scales. Referring to Fig 3, auto flattening has smoothed out any variations across the tile and the tile boundaries.

Fig 1

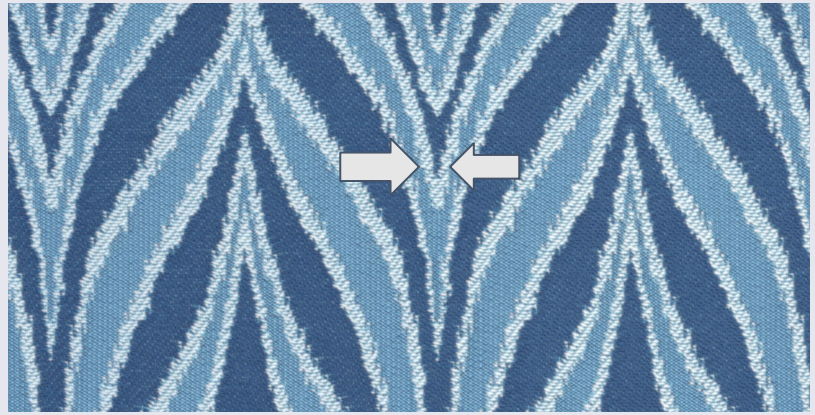


Fig 2

Fig 3

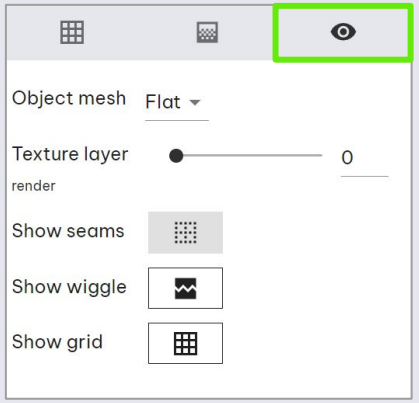
Inspecting Individual Texture Maps

Let’s look at inspecting the individual texture maps

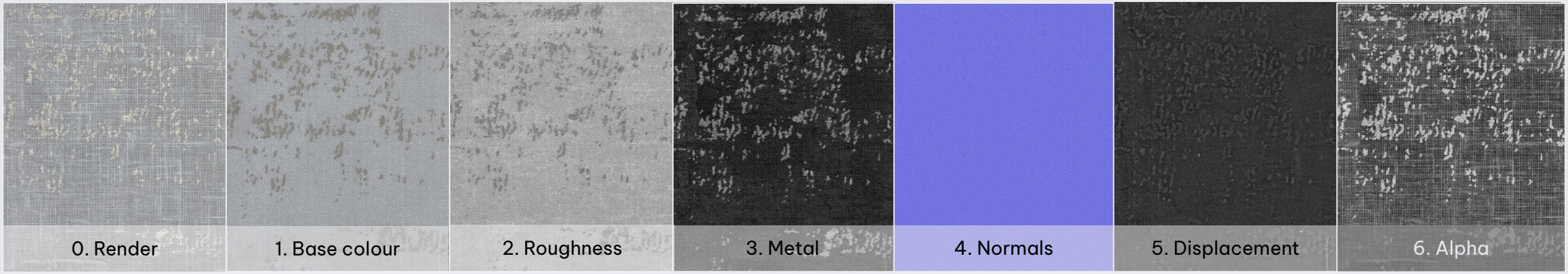
Each of the texture maps can be inspected separately to ensure they meet the necessary quality standard.

1. Click on the Visualisation tab and use the ‘Texture layer’ slider to scroll through the texture maps. Alternatively, use the keyboard shortcuts (Z & X keys).

2. Layer 0 is a render using all maps. This is useful for inspecting fine detail and checking how the digital fabric will appear when rendered in 3D tools.



Seams and other overlays can be toggled using the ‘Show’ buttons or the shortcut keys S, W and G.



Automatic Tiling

Let’s take a closer look at automatic tiling

As part of processing a material, Bandicoot automatically tiles the digital fabric.

When you first enter the Tiling Editor:

- **Tiled view** will be selected.
- The **tile seam grid** will be toggled on.
- Usually, the **Automatic tiling** tab will be active in the main tiling window.

  If the **Manual tiling** tab is active when you first open a newly processed material, it means Automatic tiling did not detect the weave of the material, and manual tiling is needed.

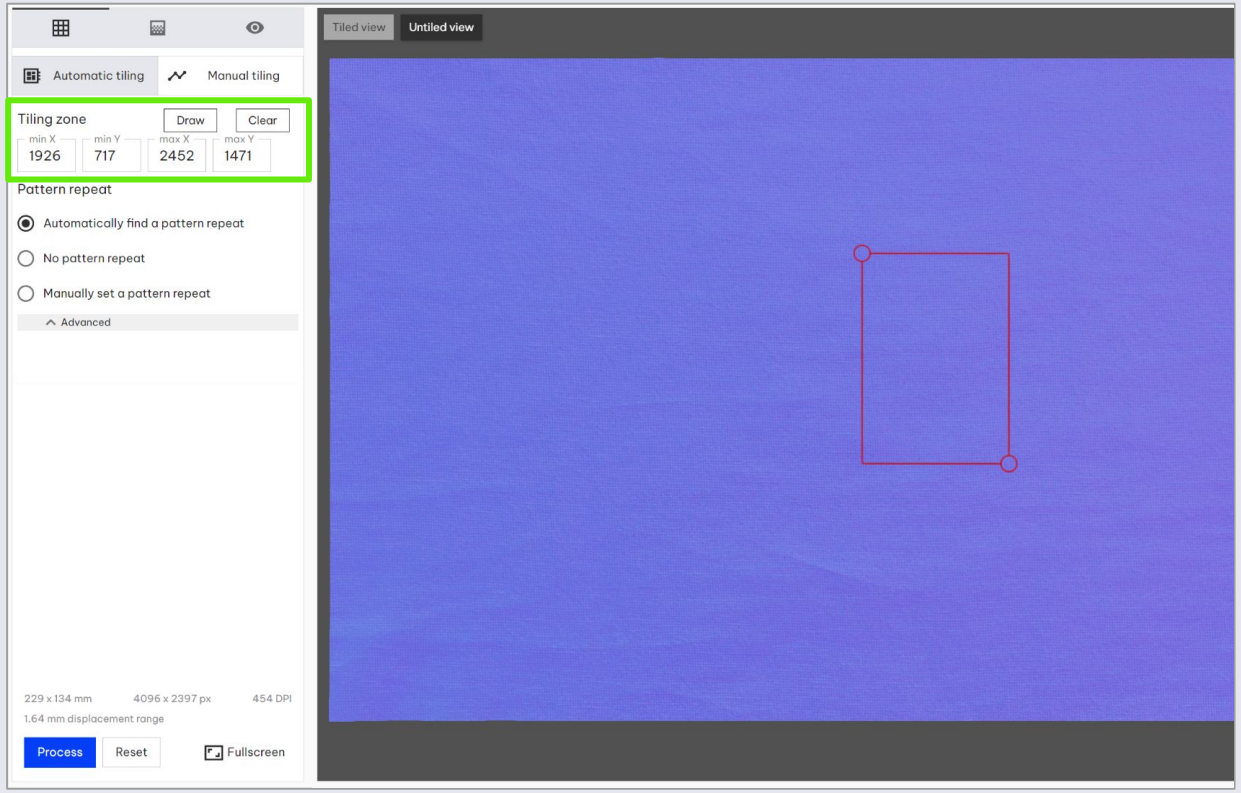
Automatic Tiling - Tiling Zone

Occasionally, automatic tiling will be successful but there may be some inconsistency in one or more of the texture maps that is unacceptable

In this example the Normal Map has creases that we would like to avoid in the tile.

The problematic areas can be excluded by setting a Tiling Zone.

1. Click the **Draw** button next to the 'Tiling zone' heading.
2. **Left click** in the Untiled view and **drag** a rectangle that covers the area that you wish to use for tiling. The zone you draw only needs to be approximate as the automatic tile processing will still match the seams precisely at the edges.
3. Click the **Done** button.
4. The pattern repeat setting affects how the Tiling Zone operates:
    a. If 'No pattern repeat' is selected, the result will be the closest tile to the drawn Tiling Zone that matches the weave across opposite seams.
    b. Otherwise, the result will be closest tile to the drawn Tiling Zone that matches both the weave and the pattern repeat across opposite seams.
5. Click **Process** and wait for the results.

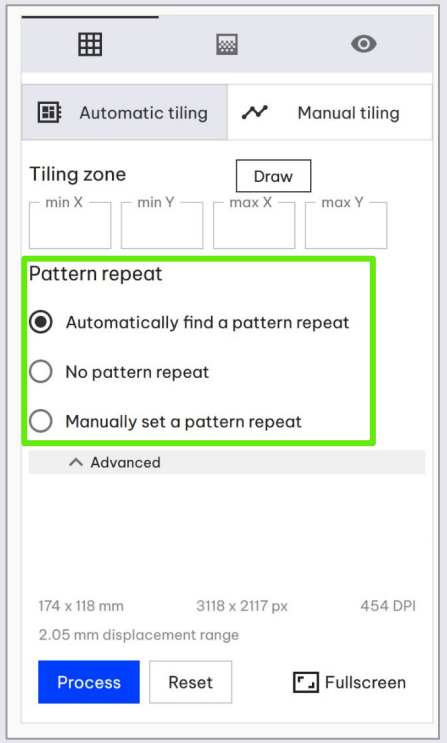


Automatic Tiling - Pattern repeat

Controls for the large pattern repeat

If there is no pattern repeat, you can select ‘No pattern repeat’ so that the Tiling Editor has more freedom to automatically select the best tile corners.

If WeaveLock successfully detects the yarn but WeaveSearch is unable to detect the large repeat pattern, the pattern repeat can be adjusted using ‘Manually set a pattern repeat’. These controls will be covered in a future Advanced Tiling Guide.



Manual Tiling – When is it needed?

Occasionally, automatic tiling will not detect the yarn or the repeat pattern

If **WeaveLock** was **unsuccessful**

- Some fabrics, such as velvet, have no visible weave which means that WeaveLock is unable to detect the weave (Fig 1).
- In other fabrics, there is a visible weave, but WeaveLock detects the wrong angle of the weave (Fig 2).

If **WeaveLock** was **successful** but **WeaveSeach** was **unsuccessful**

- In other cases, WeaveLock is successful but WeaveSearch is unable to detect the large repeat pattern (Fig 3).

These cases can be corrected using **manual tiling**.

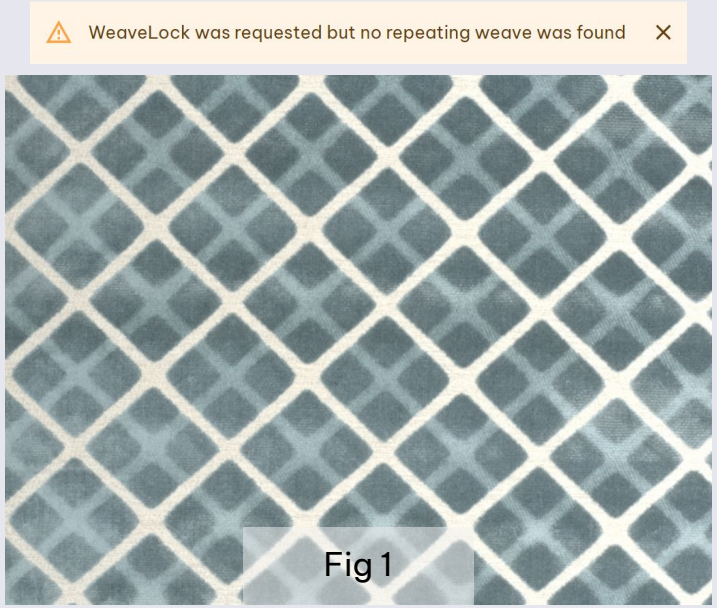


Fig 1

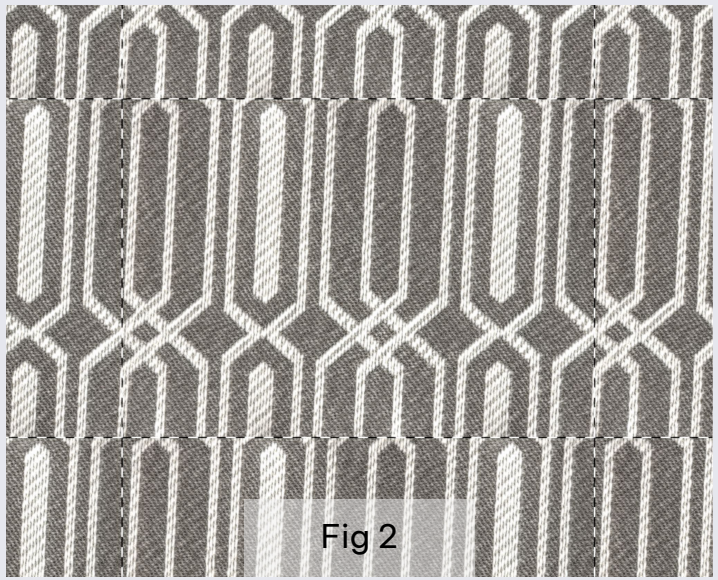


Fig 2

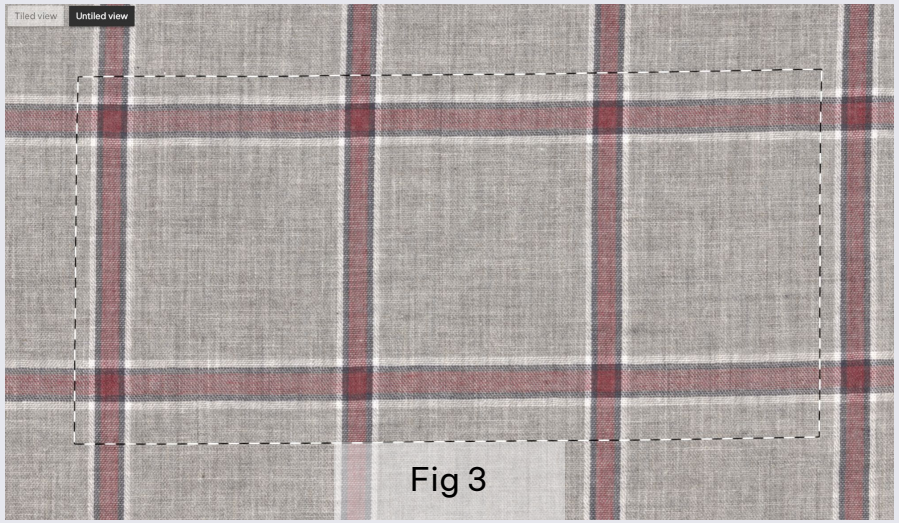


Fig 3

Manual Tiling - Corners

Let's take a closer look at manual tiling

Sometimes it is necessary to manually set the tile region.

1. Click the **Untiled view** button.
2. (Optional) Choose a texture map using the Z/X keys that clearly shows the full tile.
    a. Normally this is the base colour, but for some fabric types it might be easier to work with another map.
3. Zoom in or out using the mouse wheel and pan using right-mouse-button drag to show the full tile region.
4. Left click and drag a rectangle that covers the full tile region.
5. This initial rectangle can be approximate since we refine it in the next step.
    a. The corners of this rectangle are the **corner points.** Fig. 1 shows a closer view of the corner point placement, Fig. 2 gives an overview.
    b. When choosing the corners, look for a distinct feature that will be easy to locate precisely on all 4 corners.

Fig 1

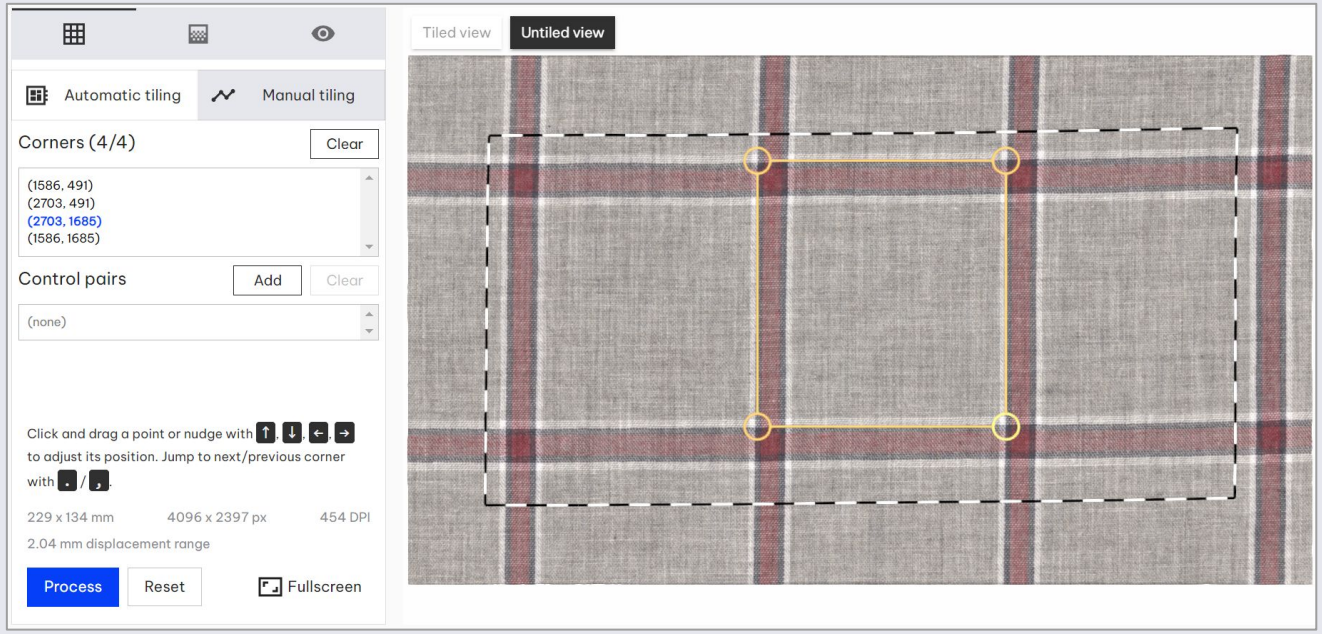


Fig 2

Manual Tiling - Refining the corners

Now let's refine the corners

1. Using the mouse wheel and right-mouse-button drag you can zoom and pan into each corner point and refine to ensure a good seam.
2. Left click on a corner point to highlight it.
3. To refine, either drag the corner points with the mouse or use the arrow keys.
4. When you are satisfied the corner points are correctly positioned, click **Process** and wait for the results.

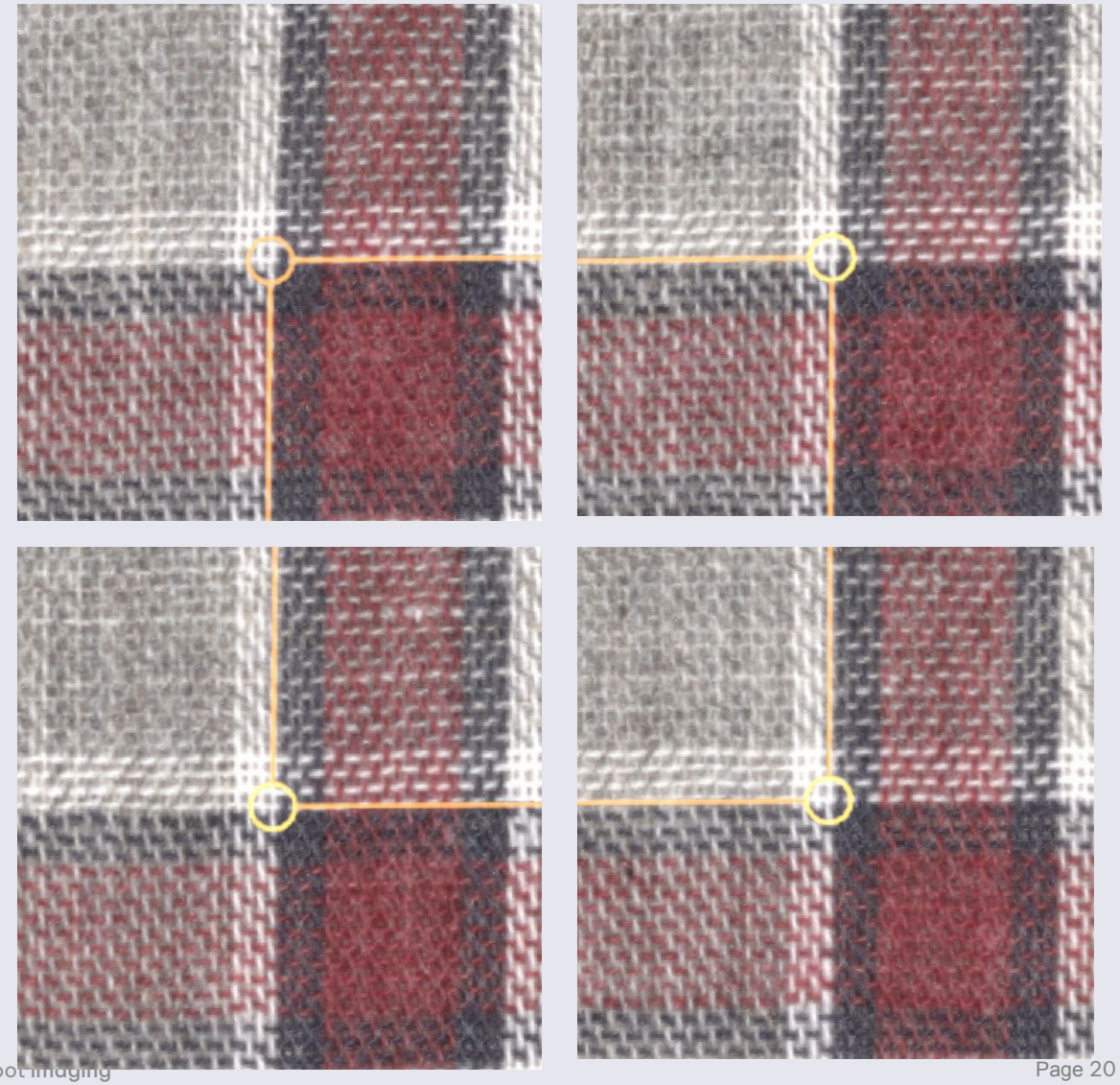
If the result is satisfactory then no more needs to be done.

In the event there is still a pattern mismatch across the tile seams, then there are two options.

1. You can continue refining the accuracy of the corner points and click Process again.

or, if the corner points are accurate but the tile is still not seamless,

2. You can add **control points** to help align features across a tile seam (see next slide).

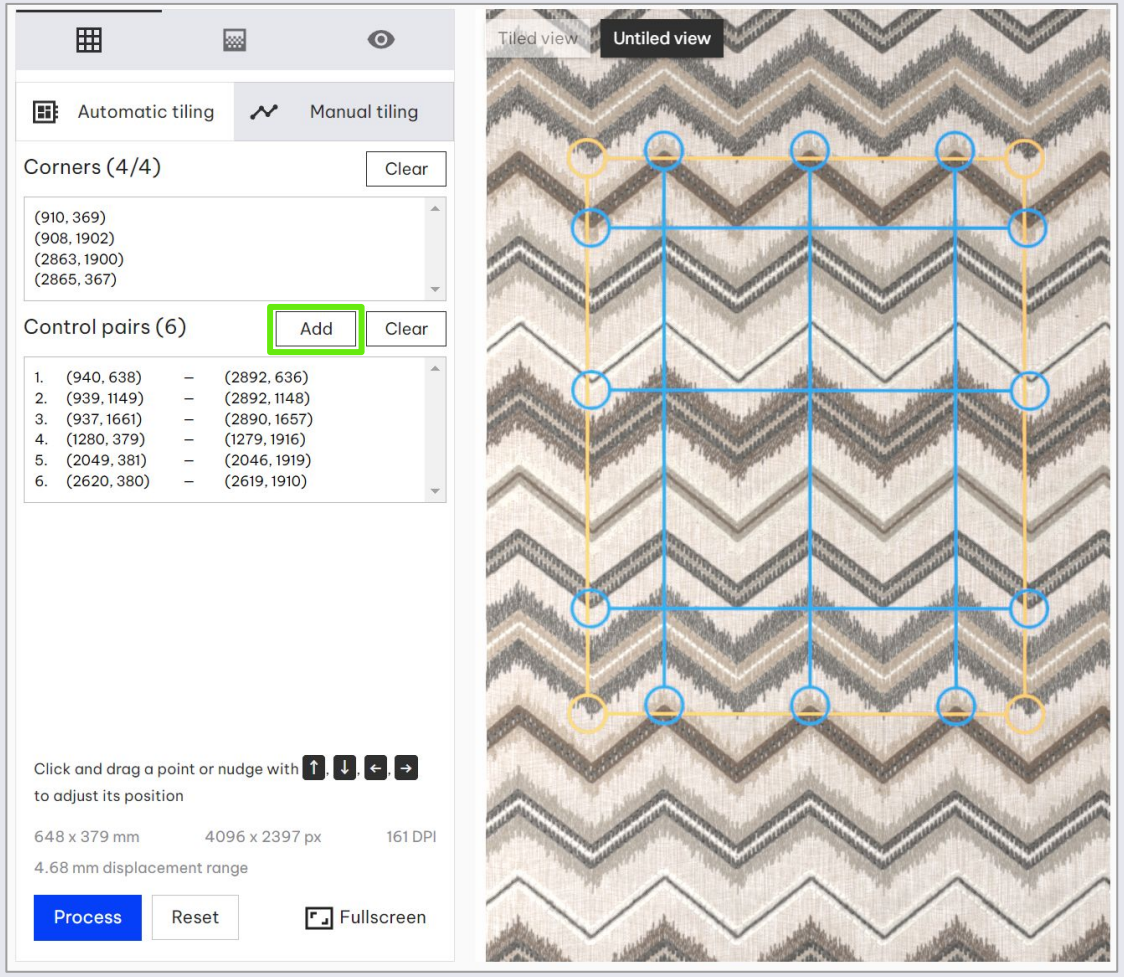


Manual Tiling - Control points

Let's take a closer look at control points

Control points can line up misaligned pattern features across a tile seam. This is more likely to be needed for very flexible materials.

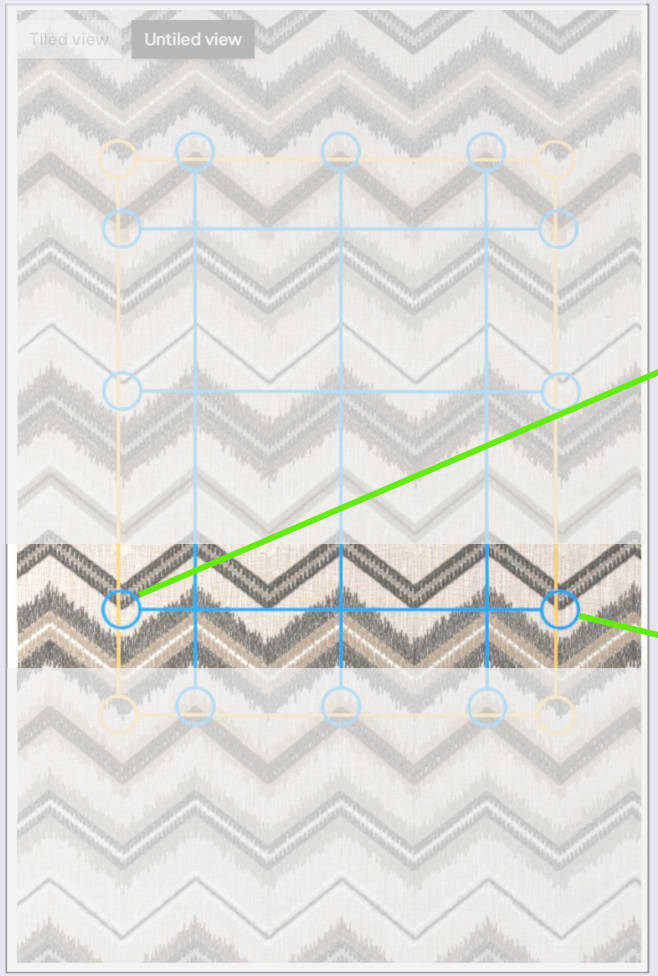
1. Using the mouse wheel to zoom and right-mouse-button drag to pan, adjust the view to make all the corner points visible.
2. Click the **Add** button next to 'Control pairs'.
3. Locate a matching feature in the fabric pattern on opposite sides of the tile near the tile seams (e.g. top seam and bottom seam), and click on each feature in the pair to place a pair of control points.
    a. This can be approximate since we will refine them in the next step.
    b. Note that usually, when one control point falls **inside** the tile region, its pair will fall **outside** the tile region.
4. You should usually aim for around 10-20 pairs of control points. More flexible materials will need more points.
5. Click **Done** when finished.



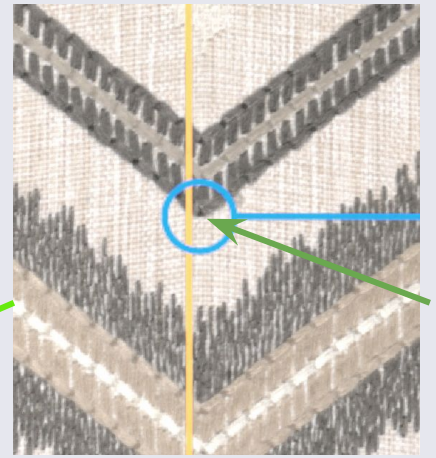
Manual Tiling - Refining control points

Refining the control points

1. Now you can zoom in and pan to each control point and refine each one to ensure they are all accurate.
    a. Each control point in a pair should have the same pattern feature in the centre of the point.
    b. Left click and drag a point or nudge with the arrow keys to adjust its position.
    c. You can jump to the opposite point in a control pair using the M key.
2. Jump to the next pair of points using the . (period) key and refine it by repeating Step 1 above.
3. Do this for all the control points.
4. When you are satisfied the control points are correctly positioned, click **Process** and wait for the results.
5. Add more control points if needed and re-process.

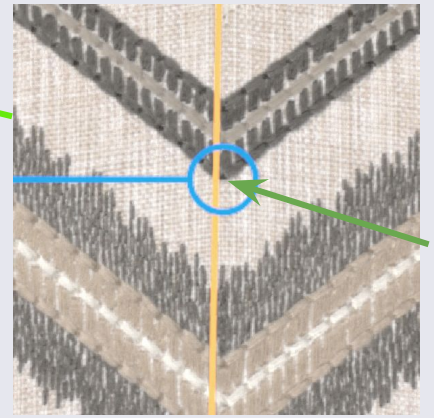


Control pair



Pattern feature in first repeat

First control point in pair



Same pattern feature in second repeat

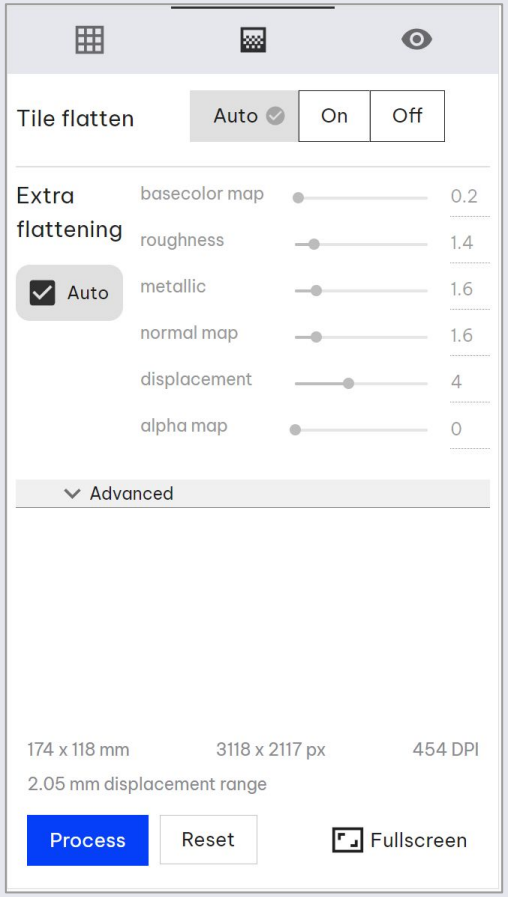
Second control point in pair

Correcting Texture Variations

Let's take a closer look at flattening

Flattening is applied automatically or manually to ensure that banding and other variations across tiles are not visible.

1. If there is a brightness gradient across the tile, there may be visible banding when zoomed out to show multiple tiles.
    a. Bandicoot corrects this banding automatically via **Auto Tile Flatten** and **Auto Extra Flattening**, while minimising the impact on the colour or character of the material.
    b. If the tile seams are in the wrong place, automatic flattening may fail and get switched off. If you leave it set to Auto, then after you have corrected the tile seams the Tiling Editor will retry automatic flattening.
2. High contrast and colourful fabrics sometimes show increased variation in the base colour when flattening is increased.
    a. This is called "haloing" or "blooming".
    b. For these fabrics, Extra Flattening in the base colour must be very small or zero to avoid haloing. This is handled automatically in Auto mode.



Correcting Texture Variations

3. Automatic tiling produces a high quality result for most materials. If there are visible issues in the tiling such as banding, colour bloom, or loss of character then you can fix these issues manually using several approaches:

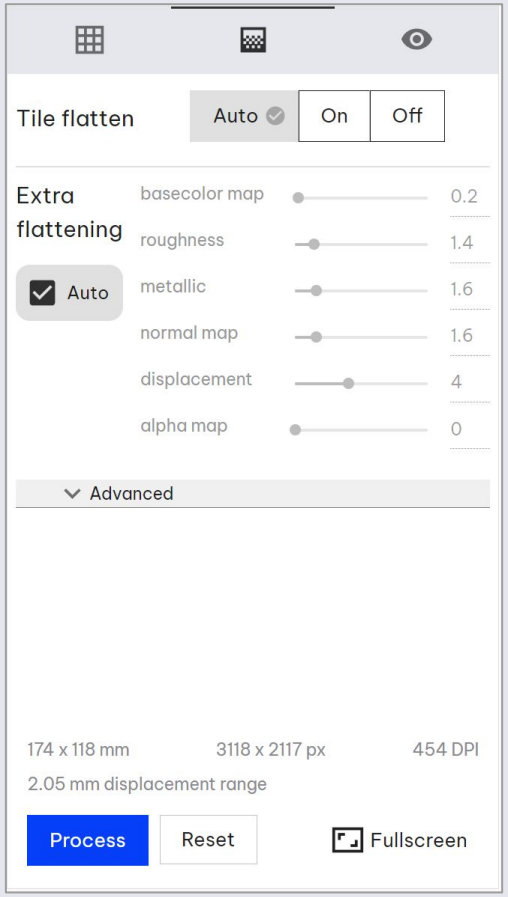
   a. If the tile seams are not correctly aligned, then adjust the tile boundaries. Once the seams are aligned then this will allow **Tile Flatten** to produce the best result.

   b. To adjust the amount of flattening, switch off **Auto Extra Flattening** and then adjust **Extra Flattening** in the affected texture maps.

      i. Increasing the flattening amounts reduces the visual variation across the tile.

      ii. However, too much flattening can destroy the character of the material.

   c. If there are still gradient issues, then manual flattening in another image editor may be required.



Tips and Tricks

- You can fine tune the alignment of corners and control points using the **Jump** keys:
    - Zoom and pan into a corner or control point, then click on the point to select it.
        i. For corners, press the , (comma) and . (period) keys to **jump** around the corners (comma moves anti-clockwise and period moves clockwise).
        ii. For control pairs, press the M key to **jump** between opposite points in the same control pair.
    - After the first jump, the features on the material around the point should stay aligned on each jump.
    - Fine tune the position of a point if needed using left-mouse-button drag or using the arrow keys to nudge the position.
    - If you are working with control pairs, you can press the , (comma) and . (period) keys to move to the next or previous control pair.
- If the texture is too bright to see in the tiling editor:
    - Exit the tiling editor.
    - Reduce the Light Intensity slider.
    - Go back into the tiling editor.

Anatomy of a Digital Fabric

3D render using these maps

A digital fabric consists of texture maps that 3D design software uses to render photorealistic images of fabrics.

A renderer uses the texture maps to accurately simulate how light interacts with a digital fabric. This leads to photorealistic effects like soft shadows, sharp highlights, and subtle variations in how the fabric responds to light.

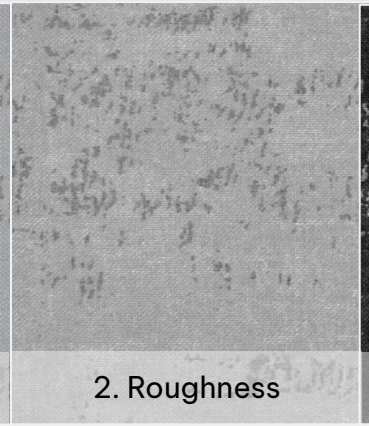
The maps are saved as a set of PNG files. Sometimes they are bundled together in the one file such as ZFAB (CLO3D), GLTF (CLO3D) or U3M (Browzwear). These files are imported into the 3D design software.

0. Render

Shows the overall appearance

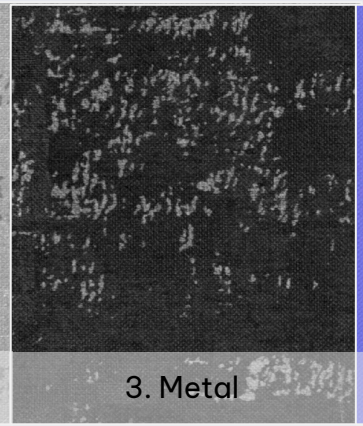
1. Base colour

The diffuse color of a fabric



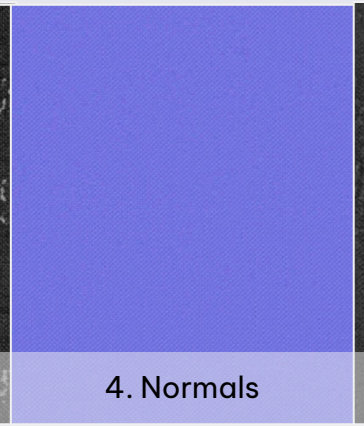
2. Roughness

How light scatters across the surface of a fabric. Darker regions result in a shiny surface whilst lighter regions give a more matte look



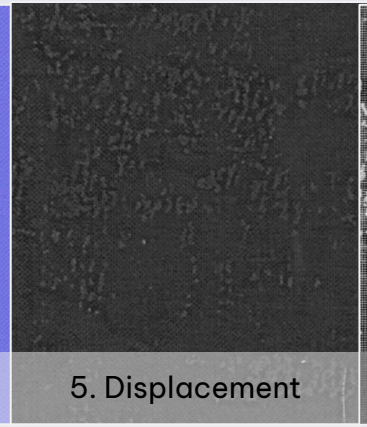
3. Metal

The metallic properties of a fabric. Lighter regions mean any shiny reflections take on the colour of the material



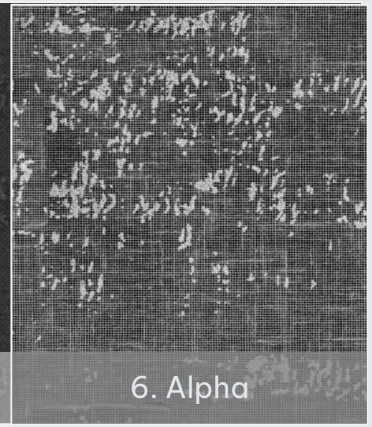
4. Normals

Gives texture by defining the angle of the fabric at each position



5. Displacement

Raise or lower regions of the fabric, resulting in extra depth detail. Used for highly elevated construction such as Jacquard or for embossing



6. Alpha

Lighter regions are opaque, darker regions are transparent. Used for sheer fabrics

Tiling editor Keyboard Shortcuts

Shortcut	Action	Comments
F	Toggle fullscreen	
G	Toggle grid	Shows WeaveLock grid in Tiled view in Automatic tiling mode
S	Toggle seams	Shows tile seams in Tiled and Untiled view
W	Toggle wiggle seams	Shows the Wiggle seams in Tiled and Untiled view if Wiggle is enabled
T	Tiled view	
U	Untiled view	
X	Next texture map	Texture map order: 0. render 1. base colour 2. roughness 3. metal 4. normals 5. displacement 6. alpha
Z	Previous texture map	
= (equal)	Show more tiles	Applies to Tiled view
- (minus)	Show fewer tiles	Applies to Tiled view

Shortcut	Action	Comments
Left-click	Select a corner or control point by clicking on it	Clear selection by clicking on a blank spot
Arrow keys	Nudge corner or control point by 1 texture pixel	
Shift + Arrow keys	Nudge corner or control point by 10 texture pixels	
. (period)	Jump to next corner or control pair	To switch between corners and control pairs, click on a corner point or a control point
, (comma)	Jump to previous corner or control pair	
M	Jump to opposite control point in a control pair	
Ctrl + Left-click	Tilt view	
Right-click drag	Pan view	
Mouse wheel	Zoom view	