Gnarl3D

Surface Textures for 3D Printed Parts

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Introduction

What Gnarl3D Does

Gnarl3D puts a surface texture onto an STL model so that the texture is printed as part of the object: wood grain, wicker, knurling, leather, stone, brickwork, or any image of your own. The texture is real geometry. Light areas of the image are raised, dark areas are sunk, and the result is saved as a new STL file that you slice and print as usual.

The file you load is never changed. Gnarl3D works on a copy, and you save the result under a new name.

How It Works in One Paragraph

A model from a CAD program has only a few large triangles on each flat face, which leaves a pattern nothing to shape. Gnarl3D rebuilds the part with small, even triangles and presses the image into it as real geometry (**Relief**), then removes the triangles the print does not need (**Simplify**). You choose where the texture goes and how deep it is; one button, **Process**, does the rest.

What You Need

- A Windows PC with a graphics card that supports OpenGL 3.3.
- An STL file of the part.
- A slicer, such as Bambu Studio, to print the result.

Gnarl3D Free and Gnarl3D Pro

Gnarl3D comes in two editions. **Gnarl3D Free** does everything in this manual and saves STL files, with three exceptions. **Gnarl3D Pro** adds:

- **Cylinder and Sphere mapping**, for bottles, tubes, handles, balls and domes (see *Mapping*).
- **Outer or inner surfaces only**, to texture the outside of a part and leave bores, slots and pockets plain (see *Which Surfaces*).
- **Mask volumes**, to keep the texture off faces that have to fit (see *Masks*).

In this manual these features are marked **(Pro)**. Gnarl3D Free shows them too, marked the same way. Cylinder and Sphere are greyed; choosing one of the others opens a screen that says what Gnarl3D Pro adds, with a button to get it.

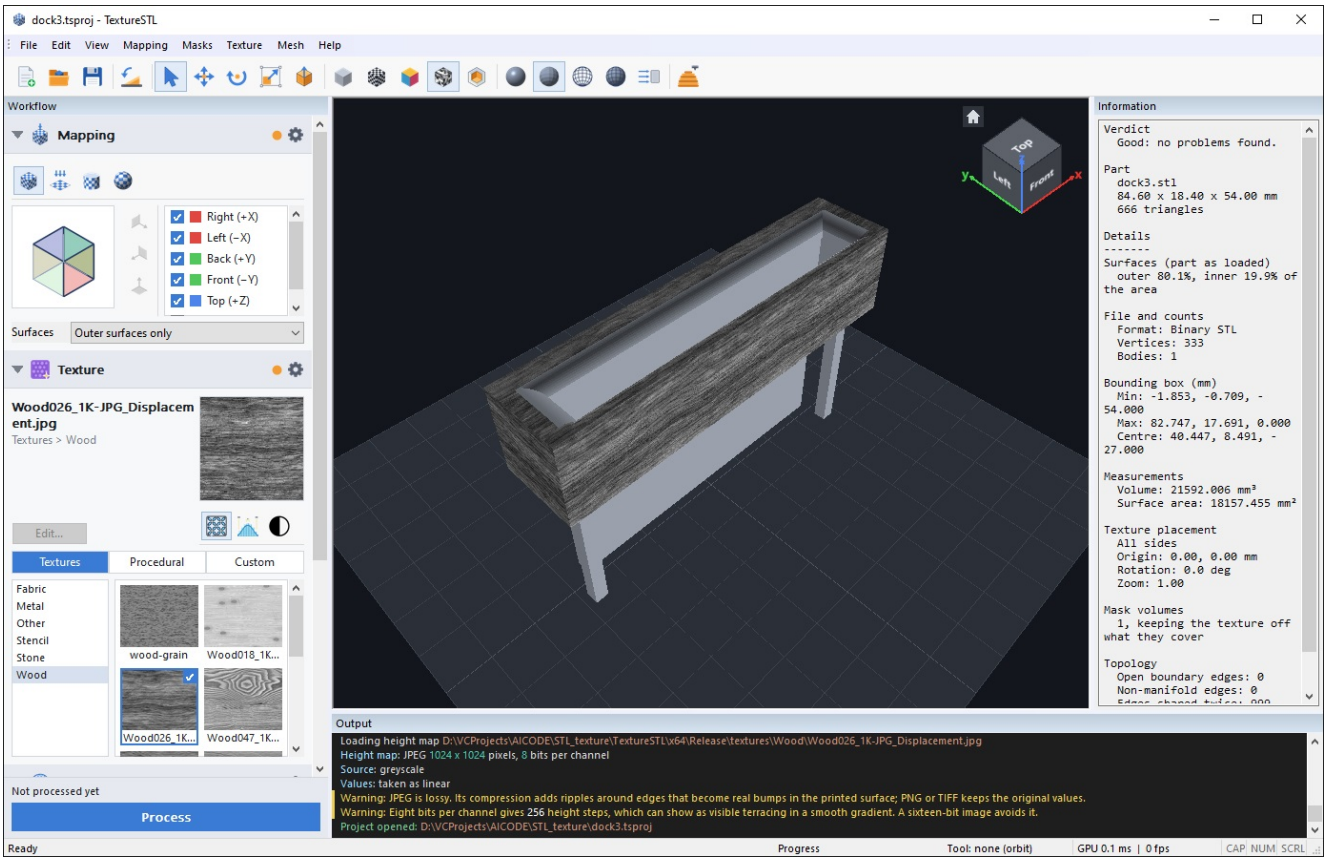
Gnarl3D Pro needs a registration code to save STL files (see *Registering Gnarl3D Pro*).

Quick Start

1. **Open a part.** Use **File > Open STL** (Ctrl+O), or drop an STL file onto the window.
2. **Pick a texture.** In the **Texture** section on the left, click a thumbnail. The texture appears on the part at once, as a preview.
3. **Set the depth.** In the **Relief** section, set **Strength** in millimetres. 0.4 to 1 mm suits most parts.
4. **Press Process** (F5). The part is rebuilt with the texture as real geometry. The dots beside each section turn green when it is done.
5. **Save.** Use **File > Save STL** (Ctrl+S). The file is repaired and checked first; when the line above the report says **Ready to save**, press **Save...** and choose a name.

That is the whole workflow. The rest of this manual explains each step and its options.

The Window



Workflow Panel (left)

The steps that make the textured part, from top to bottom: **Mapping**, **Texture**, **Relief** and **Simplify**. Each section has:

- a **triangle** to fold it away or open it,
- a **tick box** to switch the step on or off (Mapping and Texture are always on),
- a **dot** that shows its state: amber means changed since the last run, green means up to date, hollow means off,
- a **gear** that opens the step's settings, with a help page beside them.

The **Process** button stays at the bottom of the panel, with a line above it saying what will run.

View (centre)

The part, with the texture drawn on it. Before you process, this is a preview of where the texture will land. After you process, it is the finished surface.

- **Drag with the left button** to turn the view.
- **Drag with the middle button** to move it.

- **Roll the wheel** to zoom.
- **Click the cube** in the corner to look from a side; the **house** button resets the view.

Information (right)

What the program knows about the part: whether it found any problems, its size and triangle count, and further details below. A coloured strip at the bottom of this pane carries notices, such as a reminder that a very large part is being shown in reduced form.

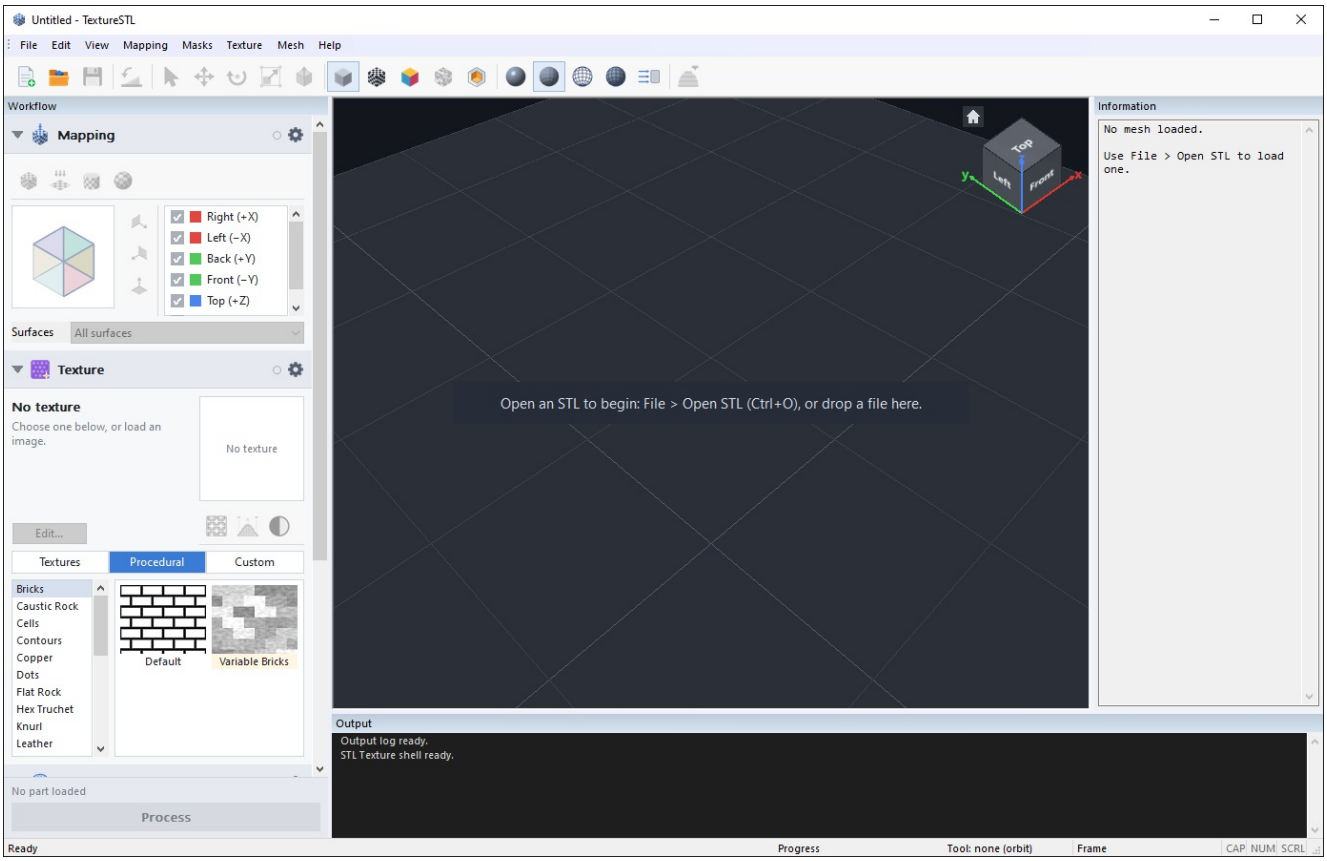
Output (bottom)

A log of what was done: what was loaded, what Process made, and what the checks found. Warnings are shown in amber.

Loading a Part

Opening

- **File > Open STL** (Ctrl+O) opens an STL file.
- **Dropping a file** on the window does the same. Dropping an image makes it the texture.
- **File > Open Project** opens a saved Gnarl3D project (see *Projects*).
- **File > Test Shape** makes a cube, cylinder or sphere to try textures on.



When a part is loaded, the Information pane gives a verdict. "Good" means nothing needs attention. If it lists problems, see *Repairing a Loaded Part*.

Standing the Part on the Bed

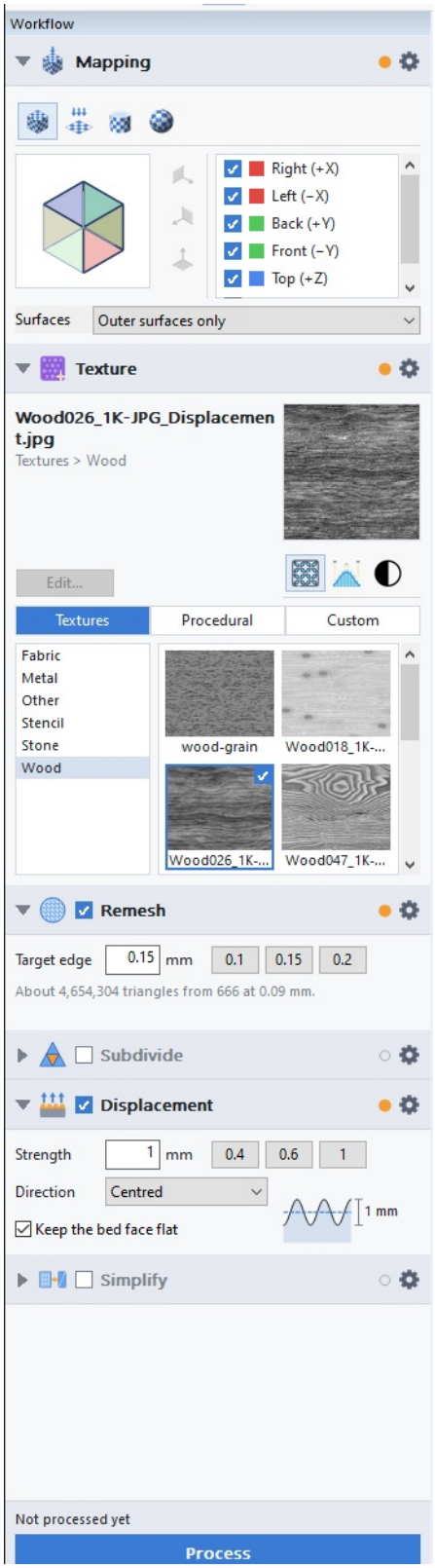
Mesh > Lay on Face turns the part so that the face you choose sits on the bed. Do this first: the bed face can then be kept flat (see *Relief*), and the print check judges overhangs from the bed up.

Very Detailed Parts

A part that arrives with far more triangles than it needs can be reduced with **Mesh > Simplify Input Mesh** before you start.

Mapping

The mapping decides from which directions the texture is laid onto the part.



Kinds of Mapping

- **Box** - from six sides. Each part of the surface takes the texture from the side it faces most. The usual choice for anything with flat faces.
- **Plane** - from one direction only.
- **Cylinder (Pro)** - wrapped round an axis, with optional end caps. For bottles, handles and tubes.
- **Sphere (Pro)** - for balls and domes. A tile keeps its size all over the ball.

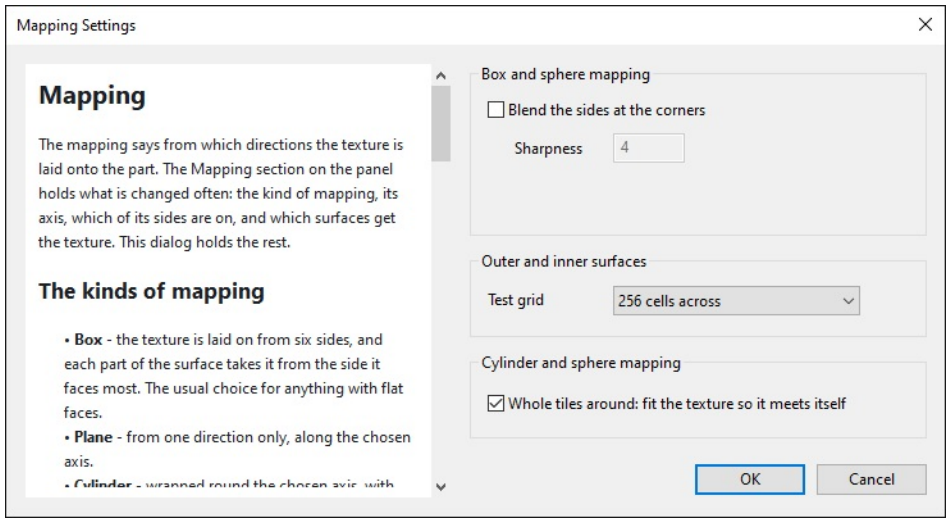
Choose the kind with the four buttons at the top of the Mapping section. In Gnarl3D Free, the Cylinder and Sphere buttons are greyed. The list beside the picture switches individual sides on and off; **Mapping > Sides** switches all, none, or inverts them.

Which Surfaces

The three **Surfaces** buttons choose which faces get the texture: all of them, the outer ones only, or the inner ones only. Each shows a tube with its textured faces checkered. An inner face is one that faces back into the part, such as the inside of a slot or a tube. **View > Surface > Outer / Inner** shows which faces count as which.

Outer only and inner only are **(Pro)**. Gnarl3D Free textures all surfaces; the **Outer / Inner** view works in both editions.

Mapping Settings



- **Blend the sides at the corners** - on a rounded corner, fades the pattern from one side into the next so no line shows. Good for noise, rock and leather. Patterns with structure, such as bricks or knurling, usually look better with a seam placed on an edge.
- **Whole tiles around** - on a cylinder or sphere (Pro), adjusts the tile size slightly so a whole number of tiles fits round and the pattern closes without a jump.
- **Test grid** - how finely the part is examined when telling outer faces from inner ones.

Raise it if narrow slots are judged wrongly.

Texture

Choosing a Texture

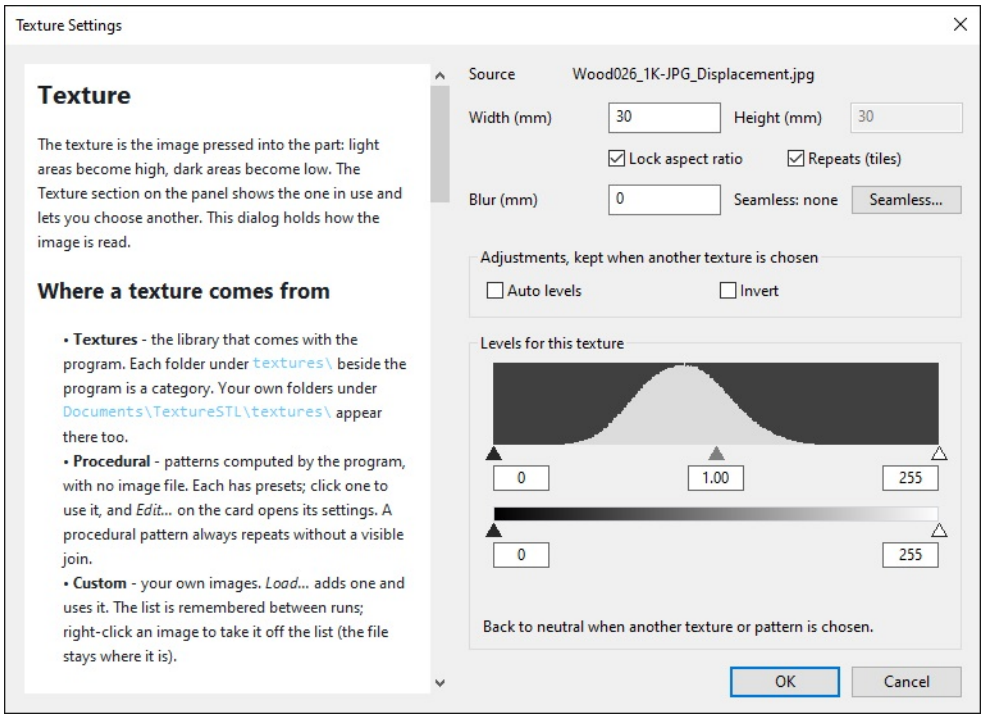
The Texture section has three tabs:

- **Textures** - the library that comes with the program, in categories. Your own folders under `DocumentsGnarl3Dtextures` appear here too.
- **Procedural** - patterns computed by the program: bricks, knurl, cells, dots and many more. Each has presets, and **Edit...** opens its settings. Procedural patterns always repeat without a visible join.
- **Custom** - your own images. **Load...** adds one and uses it.

Click a thumbnail to use it. The card at the top of the section shows the texture in use.

Size and Repeating

Open the texture settings with the gear on the Texture section.



- **Width** and **Height** are the size of one tile on the part, in millimetres. A 30 mm grain stays 30 mm whatever the size of the part.
- **Repeats (tiles)** - on, the image repeats across the part. Off, one copy is laid on and the rest of the part stays plain.
- **Blur** softens the image for a smoother look.

Adjustments

- **Auto levels** stretches the image to use its full range, so the strength you set is the relief you get. Leave it on unless you want to set the levels yourself.
- **Invert** swaps high and low.
- **Levels** work like the levels control in a photo editor: the black and white points set which grey is the bottom and the top of the relief, and the middle thumb shifts the mid-greys.

Seamless

A photograph rarely repeats cleanly, and the join shows on the part as a line. While the tile repeats, the card's preview shows it two by two, so a join shows there first.

The **Seams** row under the card chooses how the image is made to repeat. **...** beside it opens the same choice with before-and-after previews and each way's settings. The choice is remembered for each image; a new image starts with **Unchanged**, the image as it is. The three ways of removing a join:

- **Mirror** - every other tile is flipped. Nothing is lost; the cost is a mirror symmetry along each join.
- **Cross-fade** - each edge is faded into the opposite one. Quick, but slightly blurred along the edges.
- **Histogram blend** - the image is cut into patches and reshuffled. Best for stone, bark and grain; not for bricks or lettering.

Placing the Texture

The handle tools on the toolbar and in the **Texture** menu move the texture on the part:

- **Move Texture**, **Rotate Texture**, **Zoom Texture** - drag the handle in the view.
- **Edit per Side** - gives each side of the mapping its own placement.
- **Place on All Sides** - copies one side's placement to all.
- **Reset Placement** - puts it back.

Masks

A mask keeps the texture off part of the part: a bearing seat, a mating face, a threaded hole, a label recess.

Masks are **(Pro)**. In Gnarl3D Free the **Masks** menu and the **Edit Masks** button are marked (Pro), and choosing one says what Gnarl3D Pro adds.

Masks > Add Box, **Add Cylinder** or **Add Sphere** places a volume at the middle of the part and opens a small editing panel. Whatever lies inside the volume gets no texture.

- **Move**, **Rotate** and **Resize** - drag the handles. In Resize, drag the cube on a face to move that face alone; hold **Shift** to move the opposite face too.
- **Duplicate** and **Delete** - copy or remove the chosen volume.
- **Feather** - lets the relief fade in over a distance outside the volume, so its edge is a slope and not a step.
- The tick box beside a volume in the list switches it off without deleting it.

The volumes are drawn only while you edit them. Otherwise you see their effect: the texture stops where they begin.

Relief

Relief presses the texture into the part. The part is rebuilt with small, even triangles and the relief is made on them in one step. Where relief from two faces meets - an inside corner, the two sides of a thin wall - it joins into one solid rather than passing through itself, so the file is clean for the slicer.

Triangle Size

The setting that matters most for detail. Smaller shows finer detail and costs more triangles and time. Aim at **half your printer's line width**: 0.2 mm for a 0.4 mm nozzle. The buttons beside the box fill in common values, and the line under it estimates how many triangles the result will have.

A detail of the part thinner than about two triangles - a hairline gap, a very thin fin - may close up or be lost. A smaller size keeps more of it.

Strength

The height of the relief from its lowest point to its highest, in millimetres.

Direction

- **Centred** - the relief goes both out of and into the surface.
- **Outward only** - the relief only rises from the surface. The safe choice: it cannot thin a wall.
- **Inward only** - the relief is only cut into the surface.

The small picture beside the direction shows what the setting does.

Protecting the Part

- **Keep the bed face flat** - the face the print stands on stays flat and in place, and nothing ends up below it. Leave it on for anything you will print.
- **Slots and thin walls** are protected: the relief is held back where it would close a slot or cut through a wall, aiming to keep at least two triangles' width of the gap, or of the wall. A very narrow slot or a wall at a steep angle can still come out thinner, so look at thin features after Process.

Further Settings

The gear opens the rest: the **midlevel** (which grey in the image means no movement; **Automatic** sets it to suit the direction), the **triangle limit** (a run that would make more triangles is refused before it starts) and the **display limit** (above it the view shows a reduced copy tinted blue; the part is still processed, checked and saved in full).

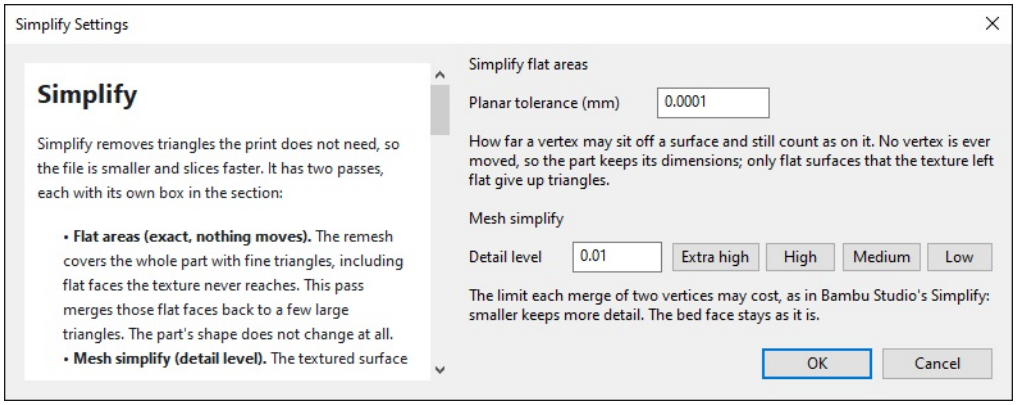
Remeshing a Part Without Texture

Mesh > Remesh Input Mesh rebuilds the part's triangles without adding relief, and replaces the part as loaded. Choose the size and the method:

- **Isotropic** - keeps every sharp edge exactly; slow.
- **Dual contouring** - fast; details thinner than the triangle size can be lost.

Simplify

Simplify removes triangles the print does not need, so the file is smaller and slices faster.



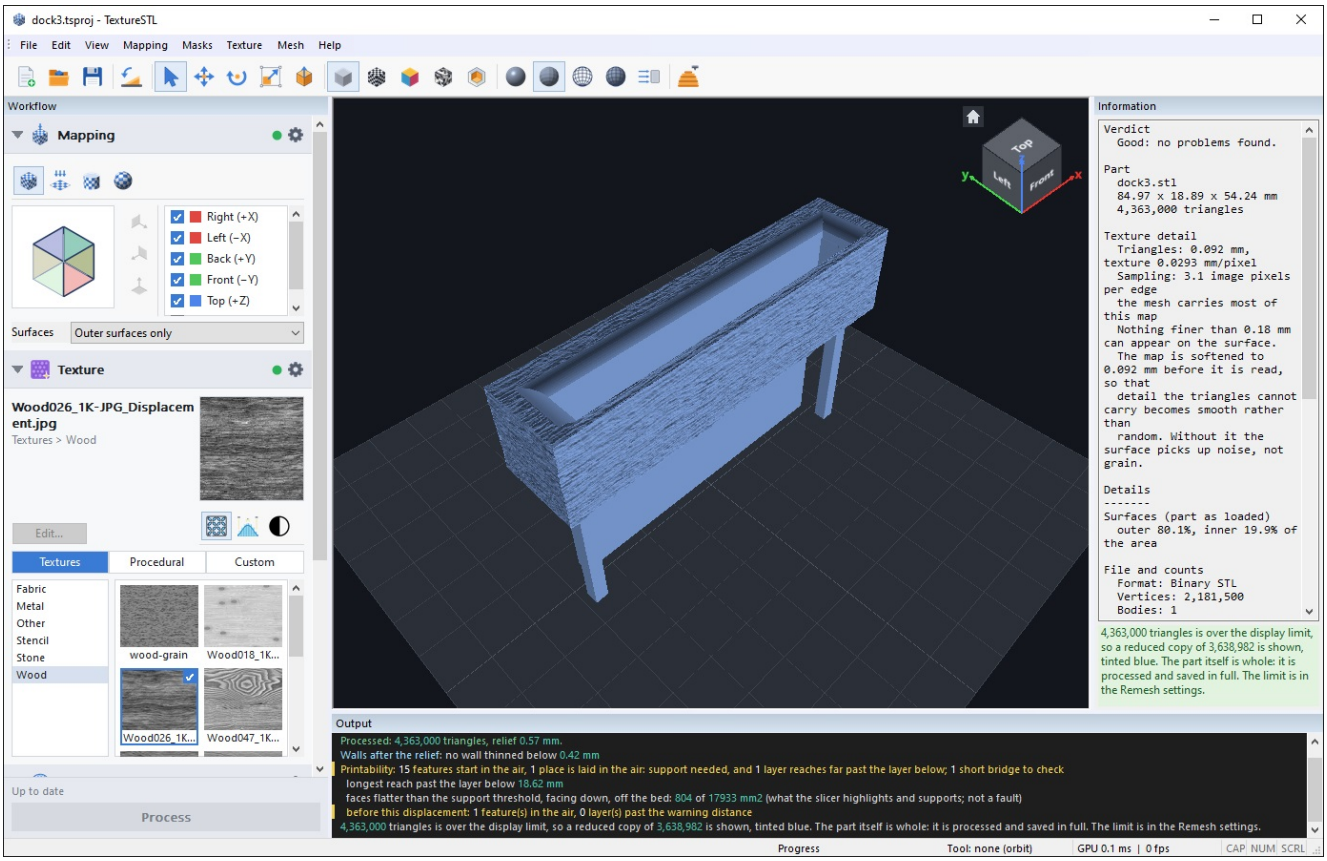
- **Flat areas** - merges the flat faces the texture never reached back into a few large triangles. The shape does not change at all.
- **Mesh simplify** - reduces the whole surface, relief included, to a detail level. The levels (Extra high, High, Medium, Low) are the same as Bambu Studio's Simplify. **High** is the default and keeps the relief intact.

Process and Check

Process

Press **Process** (F5). The button turns into **Stop** while it runs; Esc also stops it. Only the steps that changed are run again, so changing only the Simplify settings does not run the relief again.

When it finishes, the dots turn green and the view shows the finished part.



Looking at the Result

The **View** menu changes how the part is shown:

- **Shading** - smooth, flat, wireframe, or solid with wireframe.
- **Surface** - plain, checkerboard, the mapping's colours, the height map, or outer and inner faces.
- **Show** - overlays for open edges, non-manifold edges, problem faces and the print check.
- **Sliced (as Printed)** - shows the part in layers, as the printer will build it.
- **Clipping Plane** - cuts the part open to look inside.

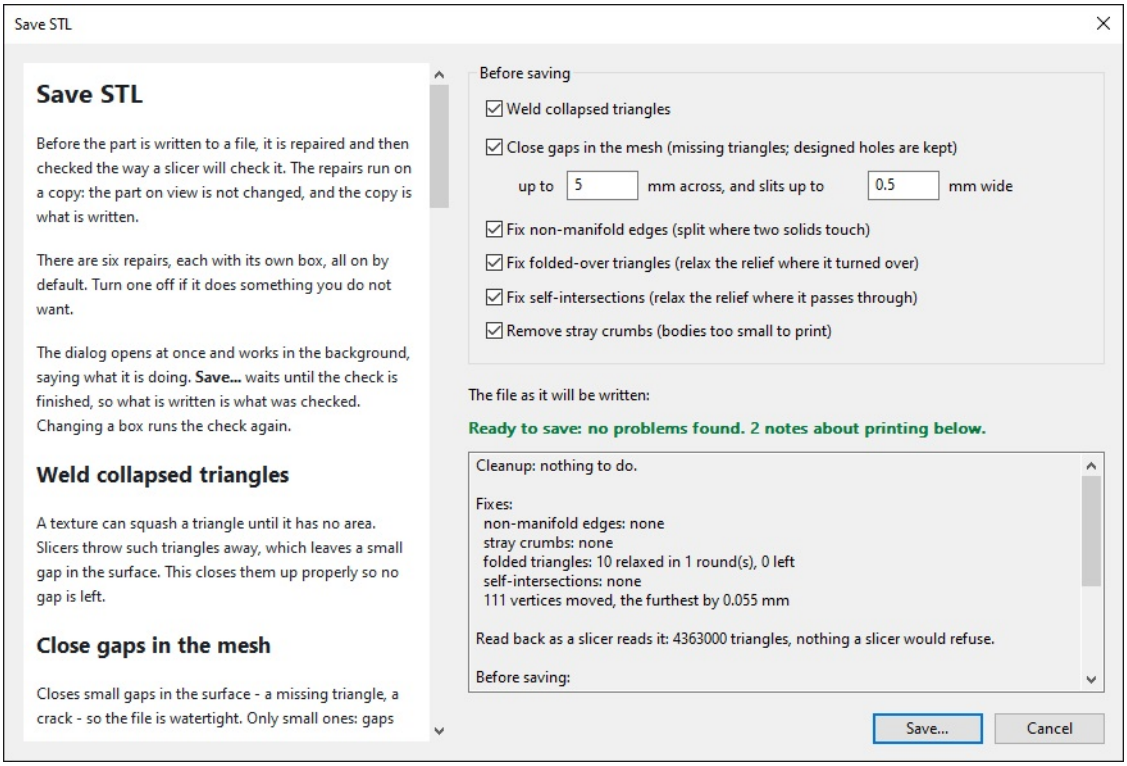
Will It Print?

After Process, the Output pane says whether the relief left anything that needs support: features that start in mid-air, or layers that reach far past the layer below. **Mesh > Check Printability** runs the check on demand, and **View > Show > Print Check** marks the places on the part.

These are reports, not changes. Support is the slicer's job; the report tells you what to expect.

Save STL

File > Save STL (Ctrl+S) repairs and checks the part before writing it. The repairs run on a copy, so the part on view is not changed.



The Verdict

The line above the report gives the answer first: **Ready to save**, in green, or the number of problems found, in amber. The report below lists what each repair did and what the check found.

The Repairs

Six repairs, each with its own box, all on by default:

- **Weld collapsed triangles** - removes triangles the texture squashed to nothing, without leaving gaps.
- **Close gaps in the mesh** - closes small gaps in the surface, such as a missing triangle. Designed holes, such as bolt holes, are never touched.
- **Fix non-manifold edges** - separates parts of the model that touch along an edge.
- **Fix folded-over triangles** - smooths places where the relief folded over and passes through itself. Sharp edges and thin fins are left alone.
- **Fix self-intersections** - separates places where one part of the surface passes through another.

- **Remove stray crumbs** - removes loose fragments too small to print.

The repairs act only where something is wrong. A part with none of these faults - for example one you load and save without texturing it - is written with its surface exactly as it was.

Turn a box off if a repair does something you do not want. Changing a box runs the check again.

Saving

Save... opens the file dialog. Choose a new name; the file you loaded is never written over. **File > Save ASCII STL** writes the text form of the format, for programs that need it.

Repairing a Loaded Part

A part that arrives broken is best repaired before you texture it. The **Mesh** menu has these tools; the ones that change the part replace the part as loaded, so open the file again if you want the original back.

- **Validate** - checks the part and lists what it finds in the Information pane.
- **Repair** - fixes everything that can be fixed without changing the shape: joins corners that belong together, removes empty and duplicate triangles, turns triangles that face the wrong way, fixes non-manifold edges, closes small gaps and removes stray crumbs. A notice then says what improved and what is left.
- **Repair with Windows** - uses Windows' own 3D printing repair, the one behind Bambu Studio's "Fix model". Slower, and useful for badly broken files.
- **Simplify Input Mesh** - reduces a part that has far more triangles than it needs.
- **Remesh Input Mesh** - rebuilds the part with even triangles, without adding relief (see *Relief*).

Triangles passing through each other are not repaired here, because fixing them moves the surface. Save STL deals with those.

Projects

A project remembers everything you set up: which part, how it stands on the bed, the texture and its placement, the mapping, the masks and every setting.

- **File > Save Project** (Ctrl+Shift+S) and **Save Project As...** write a `.tsproj` file.
- **File > Open Project** opens one, or drop it on the window.

A project stores the *location* of the part and the image, not copies of them. Keep the project, the STL and the image together in one folder and the folder can be moved or copied as a whole.

If you changed the part itself (with Repair, Simplify Input Mesh or Remesh Input Mesh), saving the project also saves the changed part next to it, as *project name* part.stl (or part 2.stl, as it takes turns), and the project opens that one. If saving fails partway, the project you saved before is left as it was.

After opening a project, press **Process** to rebuild the textured part.

A Pro Project in Gnarl3D Free

A project made in Gnarl3D Pro can be opened in Gnarl3D Free, without its Pro settings: its masks are left out, all surfaces are textured, and a Cylinder or Sphere mapping is shown as Box. A notice says what was left out.

The project file itself keeps them. **Save Project** asks for a new name instead of writing over it, so the original still opens in full in Gnarl3D Pro.

Registering Gnarl3D Pro

Gnarl3D Pro asks for a registration code before it saves an STL file. Everything else works before you register.

The code comes in the email from your purchase. It is 44 letters and numbers in groups of four:

XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX

The **Register** window opens:

- when Gnarl3D Pro starts and is not yet registered (**Later** closes it),
- from **Help > Register Gnarl3D Pro...**,
- when you save an STL file. Once a valid code is entered, saving goes on as usual.

Enter your name and the code, and press **Register**.

- **Copy and paste the code** from the email rather than typing it. Spaces, dashes and line breaks are ignored, and so is upper or lower case.
- If you do type it: the code never contains the letters O, I, L or U. An O is read as zero, and an I or L as one.
- **The name is yours to choose.** It is shown in the About box; the code does not depend on it.

The code is kept on this computer, so you register once. **Help > About** shows the name it is registered to.

Good Practice

A texture changes the surface of the part on purpose. On a decorative object that is the whole point. On a part that has to fit, hold or move, it needs some care. This chapter collects what matters most.

Texture the Outside Only

Under **Surfaces** in the Mapping section, choose **Outer Surfaces Only** (Pro) unless you have a reason not to.

Inner faces - the bore of a tube, the walls of a slot, a pocket for a nut - are usually there to fit something. A relief on them changes the fit, is hard to print cleanly inside a narrow opening, and is rarely seen. Use **View > Surface > Outer / Inner** to check which faces count as which before you process.

Functional Parts: What Changes Size

Three things change the dimensions of a part, in very different amounts:

- **The relief itself.** This is by far the largest. With **Outward only**, every textured face grows by up to the full strength: a 1 mm relief on both sides of a 20 mm block makes it up to 22 mm wide. With **Centred**, it grows by about half the strength on each face and is cut in by the other half. With **Inward only**, the outside size stays the same and the walls get thinner.
- **Rebuilding the surface.** The relief step rebuilds every face, textured or not, which moves the surface very slightly, mostly at sharp edges and corners. At a 0.2 mm triangle size it stays within a few hundredths of a millimetre of the original; a coarser size moves it more. Details thinner than the triangle size - a thin fin, a hairline gap, fine engraved text - can be lost altogether.
- **Simplifying.** The mesh pass moves the surface by a few thousandths of a millimetre on average, and by one or two tenths of a millimetre in a few places. The flat-areas pass moves nothing.

For a decorative part none of this matters. For a part that must fit, plan for it.

Keep Texture Off Anything That Has to Fit

Use **mask volumes** (Pro) to keep the texture away from:

- mating faces and anything that slides, seals or clamps,
- holes for screws, pins and bearings,
- threads,
- snap fits and hinges,
- surfaces you measure from.

A masked face gets no relief, but it is still rebuilt with the rest of the part, so it can move by a few hundredths of a millimetre. If that matters, use a smaller triangle size and consider turning **Mesh simplify** off.

In Gnarl3D Free, switching off the side of the mapping that faces such a face keeps the texture off it. Every other face turned the same way stays plain too.

After Process, compare the size in the Information pane with the size of the part you loaded, and test-fit a printed sample before making a batch.

Choose the Direction for the Job

- **Outward only** is the safe default. It cannot thin a wall or cut through a thin part. Remember that the part gets bigger.
- **Inward only** keeps the outside size, which suits a part that must fit into something. The relief is held back where it would cut through a wall, but a thinner wall is a weaker one.
- **Centred** gives the most natural look for grain and stone, at the cost of both effects in half measure.

Mind Thin Walls

A relief needs material to live in. As a rule of thumb, keep the strength well under half the wall thickness for an inward or centred relief. The relief never closes a slot or cuts through a wall, but where it is held back the pattern is shallower than you set.

Keep the Bed Face Flat

Stand the part with **Mesh > Lay on Face** first, and leave **Keep the bed face flat** on. A textured bottom does not stick to the plate, and a relief that reaches below the bottom face cannot be printed at all.

Match the Texture to the Printer

A printer cannot reproduce detail finer than its line width.

- Set the **Triangle size** to half the line width: 0.2 mm for a 0.4 mm nozzle. Finer than that costs time and file size for detail that will not print.
- Size the tile so that the smallest feature you care about - a brick joint, a strand of wicker - is at least one line width across on the part. If a pattern looks busy and fine on screen, it will print as noise; make the tile larger.
- Keep the strength sensible. The presets beside the box (0.4, 0.6 and 1 mm) suit most parts. A very deep relief with steep sides makes overhangs.

Think About How It Prints

- **Vertical walls carry texture best.** The pattern is drawn by the nozzle moving sideways, at the printer's finest resolution.
- **Top faces show layer steps.** A relief on a face that lies flat is built from whole layers, so shallow detail there turns into terraces. A deeper relief or a thinner layer height helps.
- **Faces that point down need support.** A relief on the underside of an overhang adds small overhangs of its own. Check the print report after Process, and use **View > Sliced (as Printed)** to see the layers.

Hide the Seams

Where two sides of the mapping meet, a directional pattern shows a join. Put joins on an edge of the part, where they look intentional, or turn the mapping so they fall at the back. On a cylinder (Pro), leave **Whole tiles around** on so the pattern closes on itself. Patterns without direction - noise, leather, stone - can use **Blend the sides at the corners** instead.

Work Safely

- **Keep the original file.** Gnarl3D never writes over it, and you should not either. Save results under a new name.
- **Save a project.** It lets you come back and change the strength or the texture without setting everything up again.
- **Try a small piece first.** Texture and print a corner of the part, or a test shape, before committing hours to the full print.
- **Read the verdict before saving.** If Save STL reports problems it could not fix, a shallower relief or **Outward only** usually clears them.

Tips and Troubleshooting

The texture is too fine to show

A triangle size of 0.2 mm cannot show detail finer than about 0.4 mm. If the Information pane says most of the image is too fine for the triangles, make the tile larger (so the pattern is coarser on the part) or lower the triangle size.

The part comes out a rough blob

A small part has little room for a relief: one 12 mm across has space for only about 30 printed lines. After Process, a notice warns when the part is under 20 mm across, or the relief is more than a twelfth of its size. Use a shallower relief or a larger tile, or print the part larger.

Process is refused

The run would make more triangles than the triangle limit. Raise the triangle size, or raise the limit in the Relief settings if your PC has the memory.

The part turned blue after Process

The part has more triangles than the display limit, so the view shows a reduced copy. Nothing is wrong: the part itself is complete and is saved in full.

A thin detail disappeared

Details thinner than about two triangles can close up or be lost. Lower the triangle size.

The slicer reports errors

Open the saved file with **File > Open STL**, run **Mesh > Repair**, and save again. If the report in Save STL shows problems it could not fix, try a shallower relief or **Outward only**.

The registration code is refused

"That is not a valid Gnarl3D Pro registration code" means the code does not match. Paste the whole code from your purchase email instead of typing it, and check it is the Gnarl3D Pro code: a code for another program is refused. If it still fails, reply to the purchase email.

Seeing more detail in the log

View > Detailed Log adds timings and internal counts to the Output and Information

panes. It is meant for diagnosing problems and is off by default.

Keyboard Shortcuts

Action	Shortcut
New	Ctrl+N
Open STL	Ctrl+O
Save STL	Ctrl+S
Save Project	Ctrl+Shift+S
Undo	Ctrl+Z
Redo	Ctrl+Y
Process	F5
Stop processing	Esc
Reset the view	Home
Orthographic view on or off	Num 5