

Creating Assets with Photogrammetry using a rotating surface

Photogrammetry lets you to create highly realistic 3D assets using a regular camera. This guide builds on the [Photogrammetry Workflow](#) ebook, which shows you how to capture objects and materials from the real world using photogrammetry. In this guide, we show you how to use a rotating surface to rapidly produce photorealistic Assets from a composition of objects.



You can use a small object to represent a much larger version of itself. For example, a small rock with a larger scale can represent a much larger rock. Use a tileable material to make the object look realistic with its new scale. For this reason, using a rotating surface to capture small object with photogrammetry enables you to rapidly create many Assets of any size.

When capturing small scale objects, it is important that you:

- Use a very short focus.
- Use a uniform background so it does not interfere with object reconstruction.
- Manage the lighting exactly as described in the [Lighting section](#) below; your shoot must take place inside a room that is completely dark.
- Use a structure to elevate the object, when you need to capture the bottom of the object.

The method and example in this guide roots the camera and lights, and only rotates the surface the object is on.

Setting up the capture apparatus

Preparing the rotating surface and support

For the rotating surface, you can use a common wooden round wheel. Cover the platform that your rotating surface is on with black fabric. Set the rotating surface at a height that's easy to manipulate, but make sure its support is not visible during capture. If you are using a small rotating surface, you can place a tray on top of the rotating surface to capture larger objects.

This example uses a tray on a wooden round wheel as the rotating surface.



Make sure the color of your surface is different to the colors of your objects, to separate the surface from the objects. In the example below, the blue sand provides a contrasting uniform mask. Add a marker to the rotating surface, or to the tray if you are using one, so that you know when you have rotated the object a full turn during the shoot.



Preparing the Lighting

Our example only uses one light, which is an LEDGO LG-1200 SC. The light is fixed to a tripod and only moves vertically to follow the camera.



The room itself must be dark, to produce a uniform black background. This means that you must use a strong light to illuminate the object clearly. Using a strong light is also important because, when shooting, the camera must use a small aperture to put the object in a clear depth of field. The example light is covered by a polarized filter and uses LEDs so the heat from the light does not degrade the polarized film. Be aware that heat from strong lights can damage polarized film.

Setting up the Camera



Fix your camera to a tripod and only move it vertically via the tripod. The example uses a Canon 6D. A lens with a fixed focal length will produce better results than an equivalently priced zoom lens. However, the zoom lens is more flexible because it can frame specific smaller details. A close shot session requires a lot of photos, so it is time consuming. If you plan to use tileable materials on the object, a close shot session is likely to be unnecessary.

The example camera uses a 50mm lens and does not need to capture micro details. It also uses a polarized filter on top of the lens.

Camera settings in this example:

- Aperture: f/11
- Shutter speed: $\frac{1}{4}$
- ISO: 400

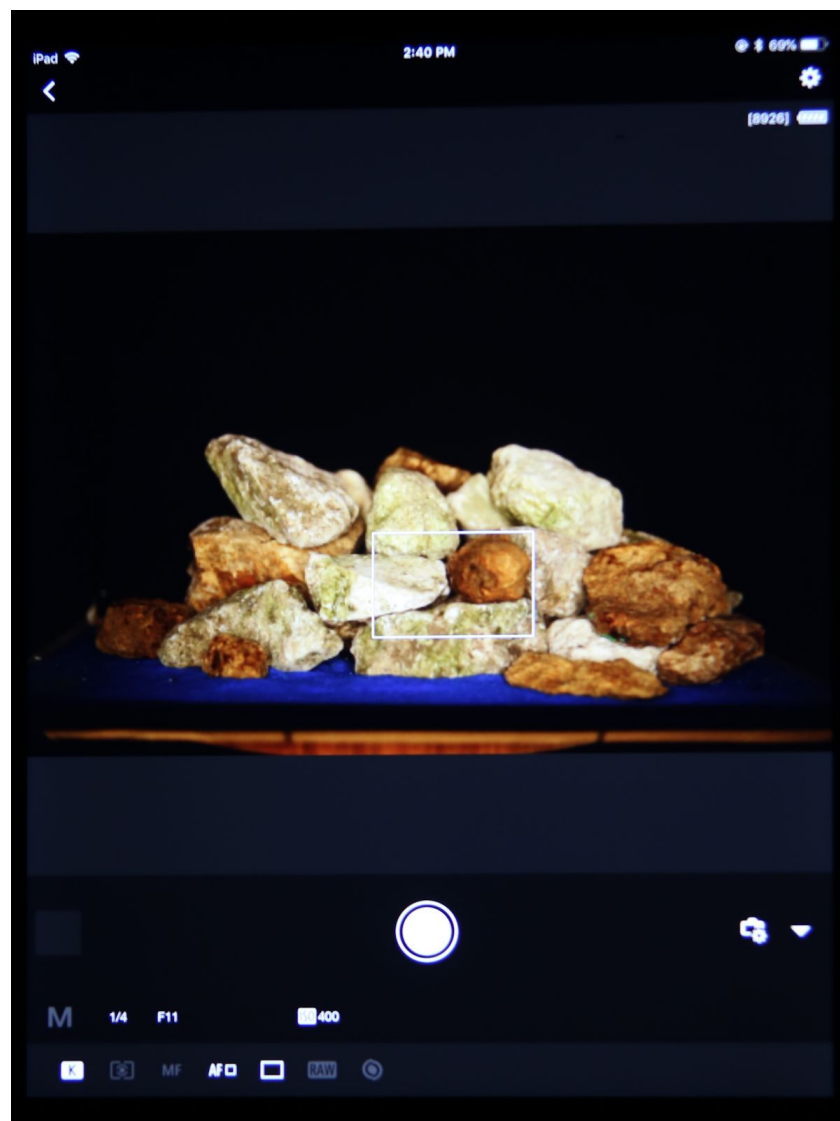
In the example, the aperture is set to f/11 to give a clear depth of field. If the ratio between the length and width of the object is not close to 1:1, you may need to use a lower aperture.

The shutter speed depends on the lighting. The stronger the lighting, the faster the shutter speed can be.

Set the ISO as low as possible. With the example Canon 6D, the ISO is set to the camera's minimum value of 100.

The correct exposure is a balance between shutter speed and ISO. The camera must have a high enough exposure without causing artefacts produced by extreme values.

The example uses a tablet running the Canon remote application and connects to the camera using Wi-Fi.



A camera remote is useful for taking photos without having to touch the camera itself. This means that you are free to rotate the rotating surface efficiently because the tablet displays the object from the viewpoint of the camera.

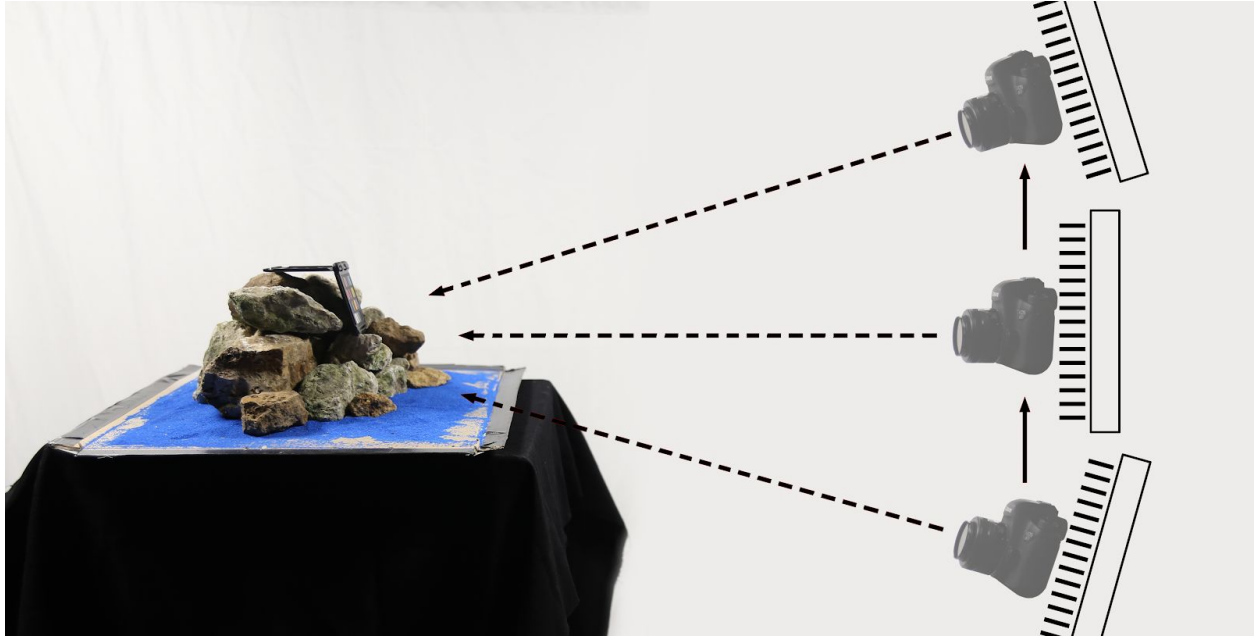
Positioning the equipment

Place the camera at a distance from the object so that it fits the object in its field of view. Place the light behind the camera as close as possible, so that the light is pointing in the same direction as the camera's view. Aligning the light and camera like this avoids shadows.

Your setup should look like this:



To cover all parts of the object, you must move the camera vertically. Be sure to move the light and camera together.



Remove all light from the room except that from the light behind the camera, like this:



Set the camera to have an exposure and depth of field that give a black background. This will be different depending on your object and your lighting, so experiment with different values until you achieve a result like this:



To remove the specular reflection caused by the light, you must use a polarized filter on the camera so that its filter is perpendicular to the filter on the light.

Taking the photos

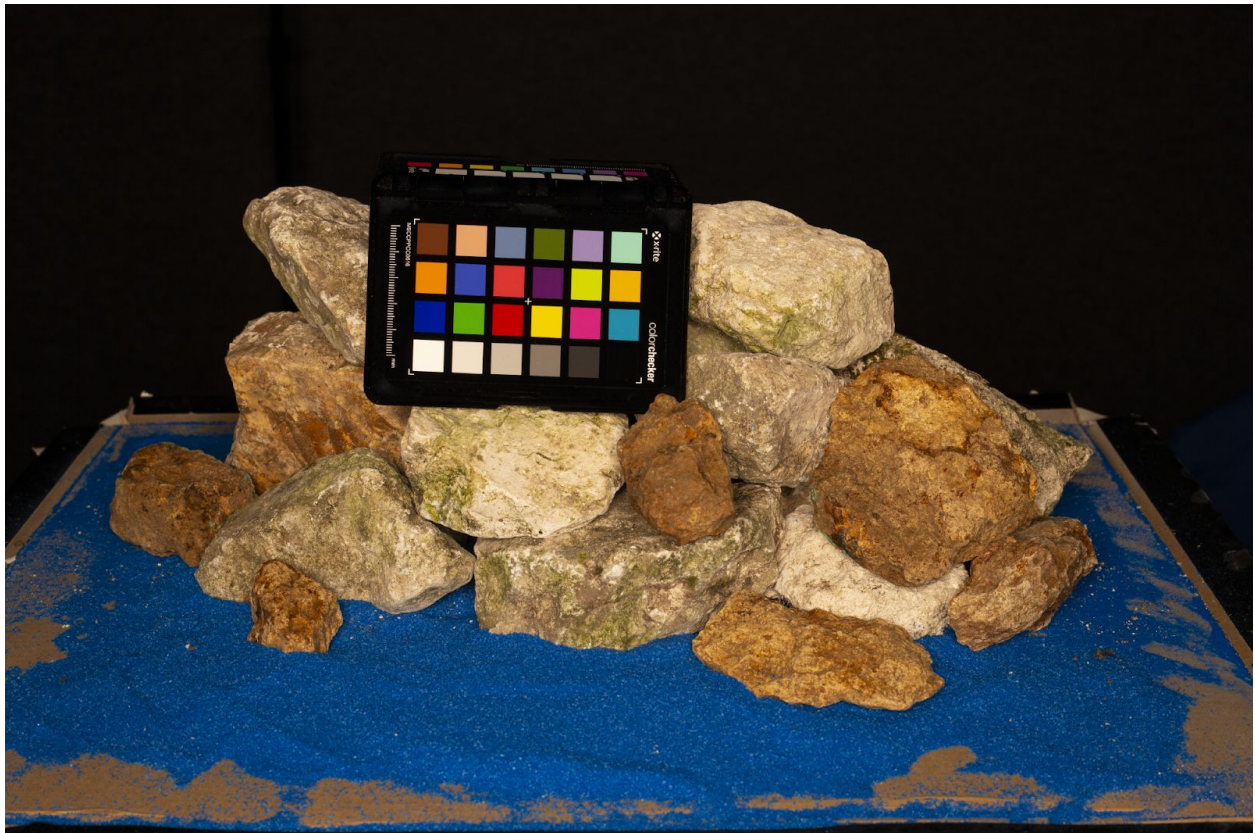
Firstly, set the focus so that the entire object or set of objects is in a clear depth of field. Remove your camera's autofocus feature.

Rotate the surface 360 degrees to make sure that the surface is stable enough and that the object is always fully in the view of the camera.

Take the first photo and then verify the quality of the focus.

Color checker

If you need the texture of the object, you must take a photo with a color checker so that you can perform the white balancing.



For information on how to do white balancing, see the photogrammetry ebook at <https://unity3d.com/solutions/photogrammetry>.

You can white balance, or base color bake, all the photos using [Knald](#). This is faster but less accurate. In the example, balancing is done using the base color of the Lit Material because it only uses the base color to influence other layers in the texture and bring some diversity.

Capture

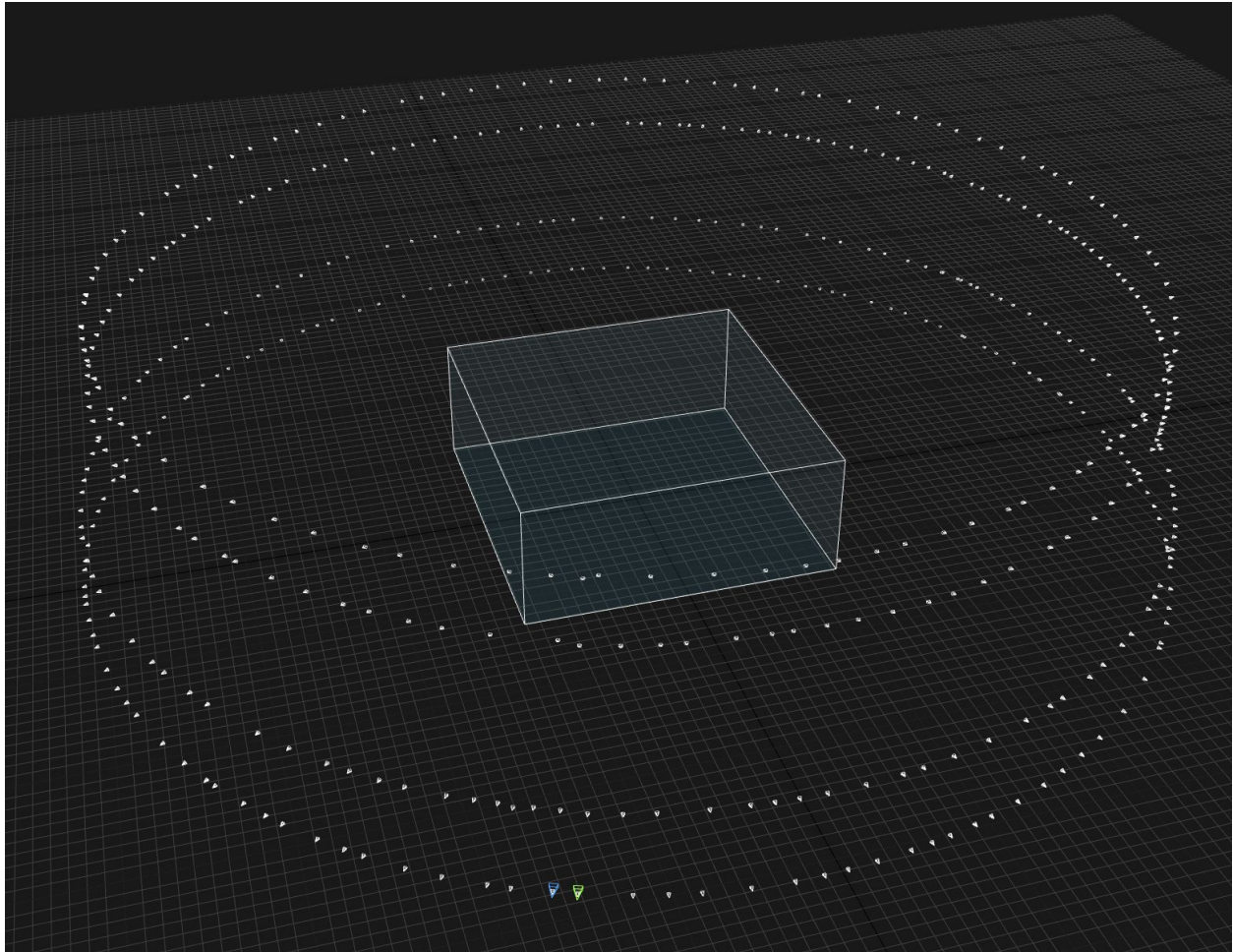
Turn the rotating surface very slowly 360 degrees and take regular photos at a consistent rate. The more photos you take, the more accurate the reconstruction will be.



Repeat the steps above at several different heights to cover all the parts of the object.

When you finish, place all the photos in some photogrammetry software, such as [Reality Capture](#), and check the alignment.

In the sample, the 360 degree photos were repeated four times at different heights for a total of 500 photos. Using these photos, Reality Capture gave the following camera alignment:



If the photos are correctly exposed, all the cameras should be in one component. If this is not the case, it could be that either the photos are not correctly exposed, are too blurry, or the background is not uniform enough. In these cases, you should redo the shots.

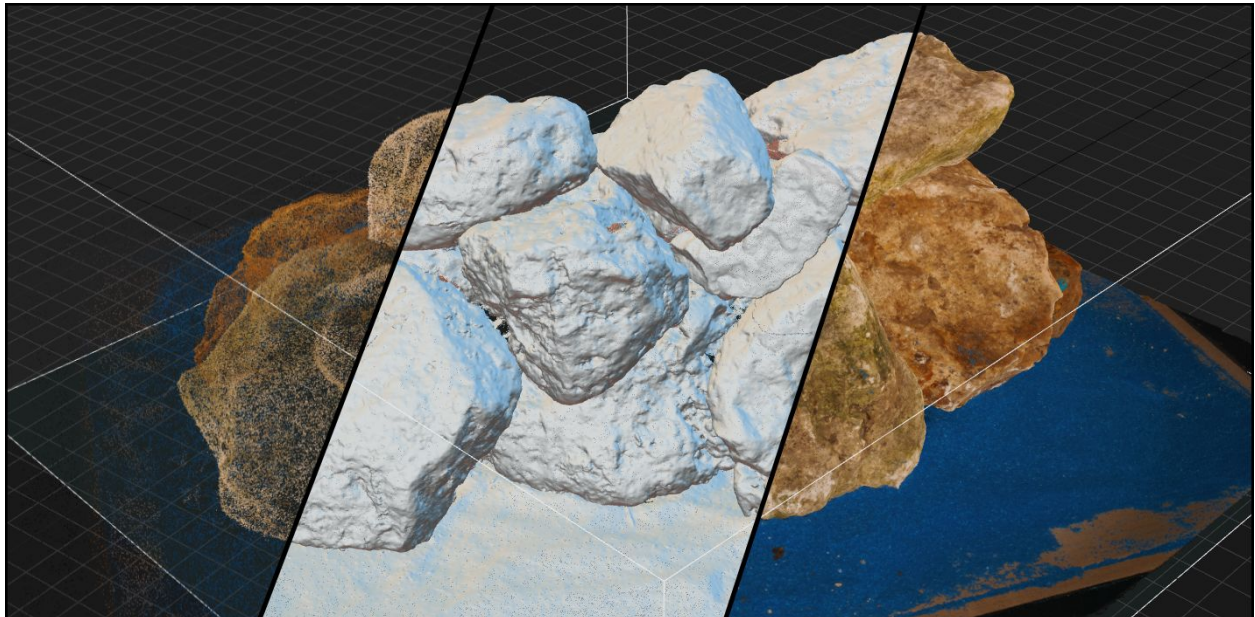
Reconstructing the model

For an explanation of the reconstruction process, see the photogrammetry ebook at: <https://unity3d.com/solutions/photogrammetry>.

This example uses the following reconstruction process:

Reality Capture - Creating the model

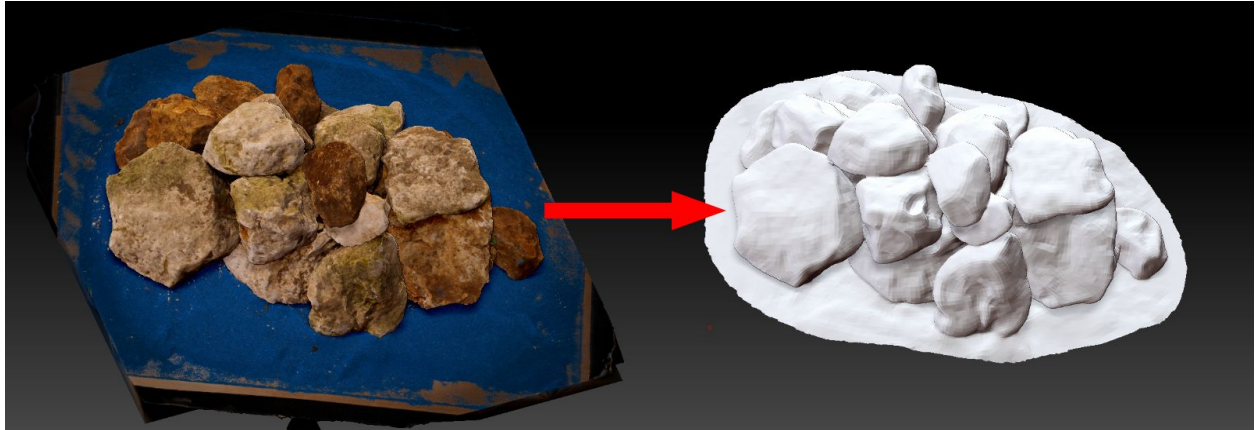
- Place the photos in Reality Capture.
- Under **WORKFLOW**, click **Align Images**.
- Click the **Calculate** button to calculate the model from the images. If the mesh has more than 20 million polygons, use the **Simplify** function to create a lower poly mesh. The texture baking process uses the high poly mesh to create a high quality texture. A reworked version of the lower poly mesh will be the destination for the high quality texture.
- Click the **Colorize** button to colorize the model.
- Export the meshes. Use the PLY format because it is more lightweight than OBJ and therefore faster to work with later.



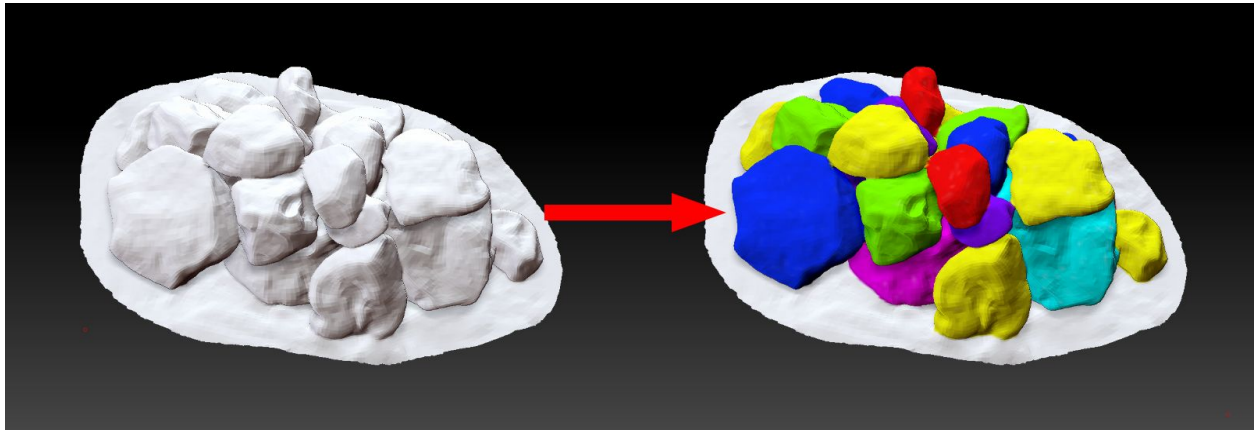
ZBrush - Model fixes and generating UVs

Install the [PLY import/export plug-in](#).

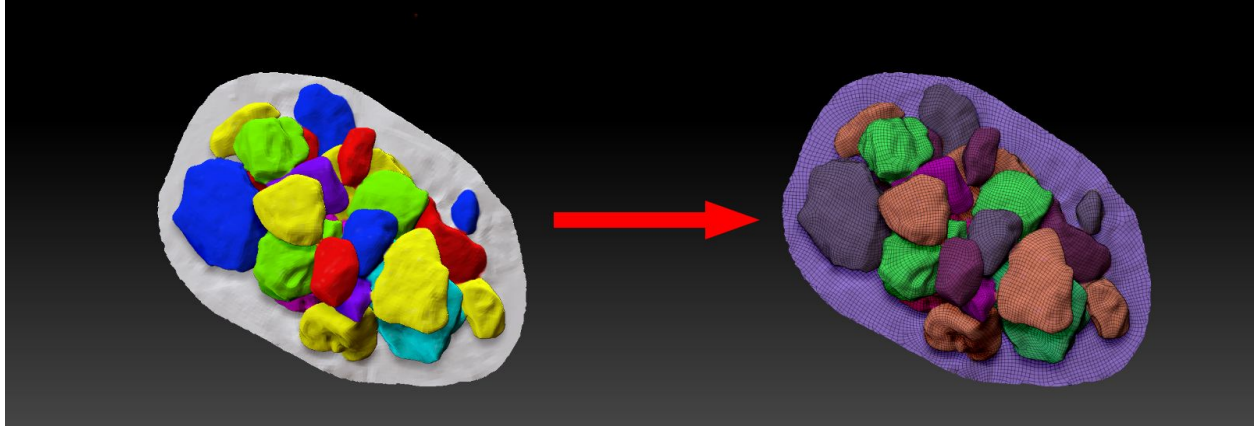
- Import the high poly PLY mesh you exported from Reality Capture.
- Reality Capture may have miscalculated certain areas of the model so check the mesh and manually correct these areas.
- Use ZRemesher to create a copy of the mesh. When you set the number of polygons that ZRemesher uses to create the copy, be aware that ZBrush expresses the polygon count in quads and not in triangles.



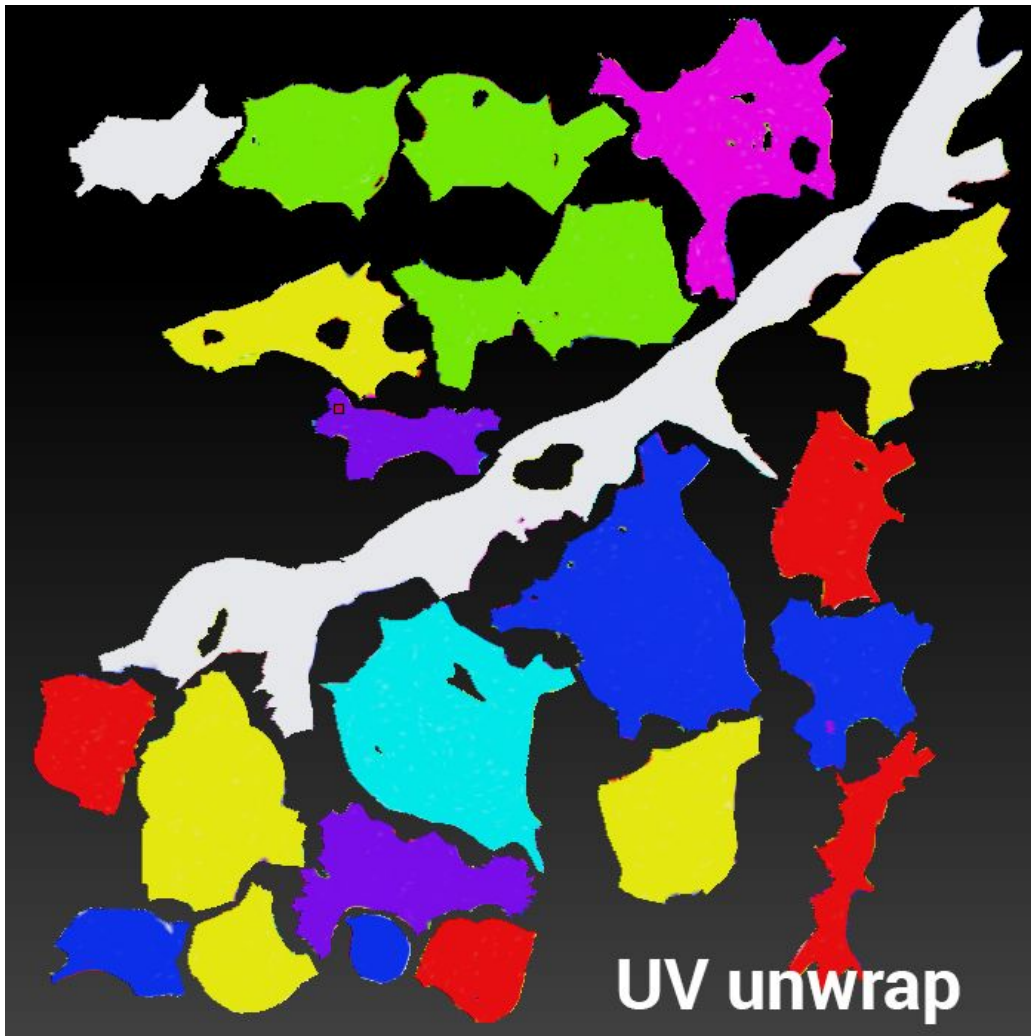
- Now, paint each element with a different color to its surroundings. You can use the same color multiple times as long as the objects with the same color do not touch.



- Use Polypaint to create Polygroups. The example uses a tolerance of 0.5.



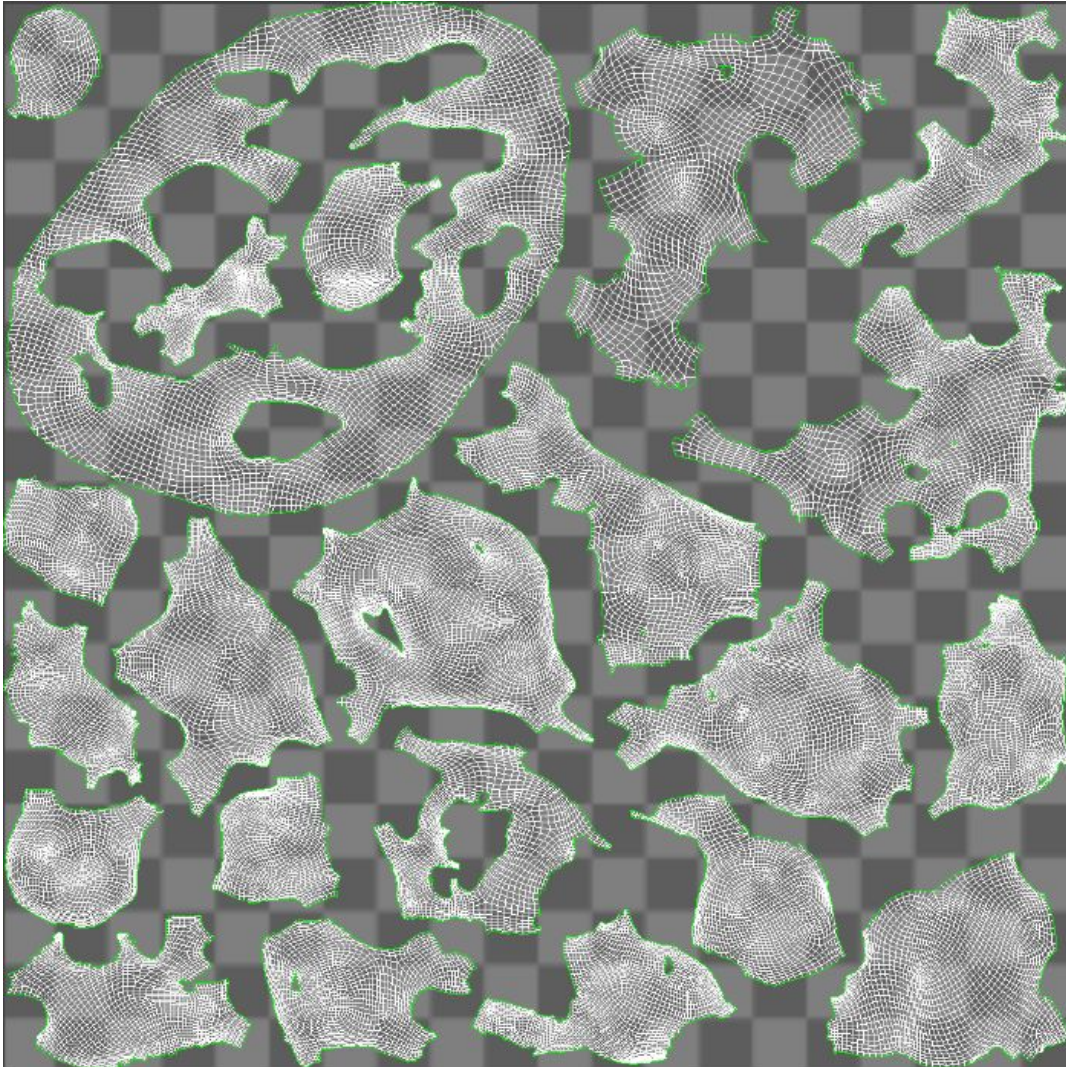
- Use ZBrush's UV Master plug-in to unwrap the model UVs. Make sure to enable Symmetry and Polygroups.



- Export the mesh using an OBJ or GoZ file format.

3ds Max or Maya - Optimizing UVs

- Import the mesh you just exported from ZBrush into either 3ds Max or Maya.
- Manage the UVs to optimize them for the object. The example uses a planar UV for the ground and scales some of the individual rock UV islands to optimize the space on the texture. This increases the quality of the individual UVs while using the same texture size.



When you scale the UVs, make sure you respect the original UV ratios.

- Set smoothing groups for the model to define that it should be rendered with smooth surfaces.
- Export the model as a low poly mesh for baking (no move, rotation, or scale from the original import).

Knald - Baking the textures:

- Import the high poly mesh from Reality Capture and the lower poly mesh from 3ds Max or Maya.
- Assign the lower poly mesh for baking and bake the base color, normal map, height map, and ambient occlusion.
- Knald does not export heightmap information, so store the minimum, middle, and maximum heightmap information in a text file. When you select a Shader that allows tessellation, assign your heightmap to the **Height Map** field. Unity then exposes the heightmap parameters for you to input the heightmap information you wrote into a text file.
- Export the textures. You can use formats such as TGA, Tiff and PNG.

3dsMax/Maya - Creating LODs and preparing the mesh

- If you need to alter your model, to change its scale or position perhaps, modify it before using it in Unity.
- Create Levels Of Detail (LODs) for the model.
- Apply different standard materials on each LOD.
- Follow the naming conventions described in Unity's [Level Of Detail documentation](#) for your LODs so that Unity can import, and set up the LODs correctly.
- Export the LODs. You should export them as one FBX so all the LODs are in one file.

Photoshop - Creating the mask map

- Create a material mask. The example uses the blue sand to select all of the ground.
- Create the mask map. For information on the format of the mask map, see the [Lit Shader documentation](#).
- White balance the base color.
- Export the mask. You can use formats such as TGA, Tiff and PNG.

Unity - Importing and using the model

- Import the model into Unity.
- Create at least two Materials for the model (Menu: **Assets > Create > Material**).
- Create a Layered Material. To do this, create a regular Material (Menu: **Assets > Create > Material**) and then change the Material's Shader to **HDRRenderPipeline/LayeredLit**.
- Assign the Materials you created above to the Layer fields in the Layered Material.

- Use vertex color painting to manage the layers and define which Material is visible on which part of the model.

