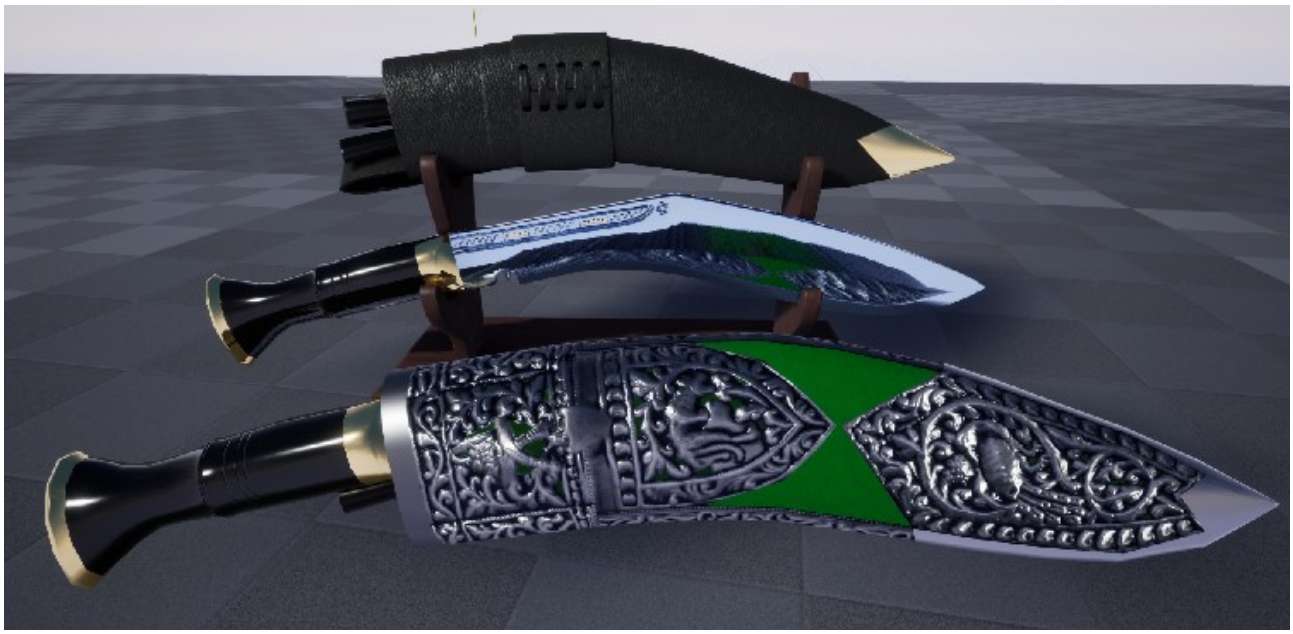
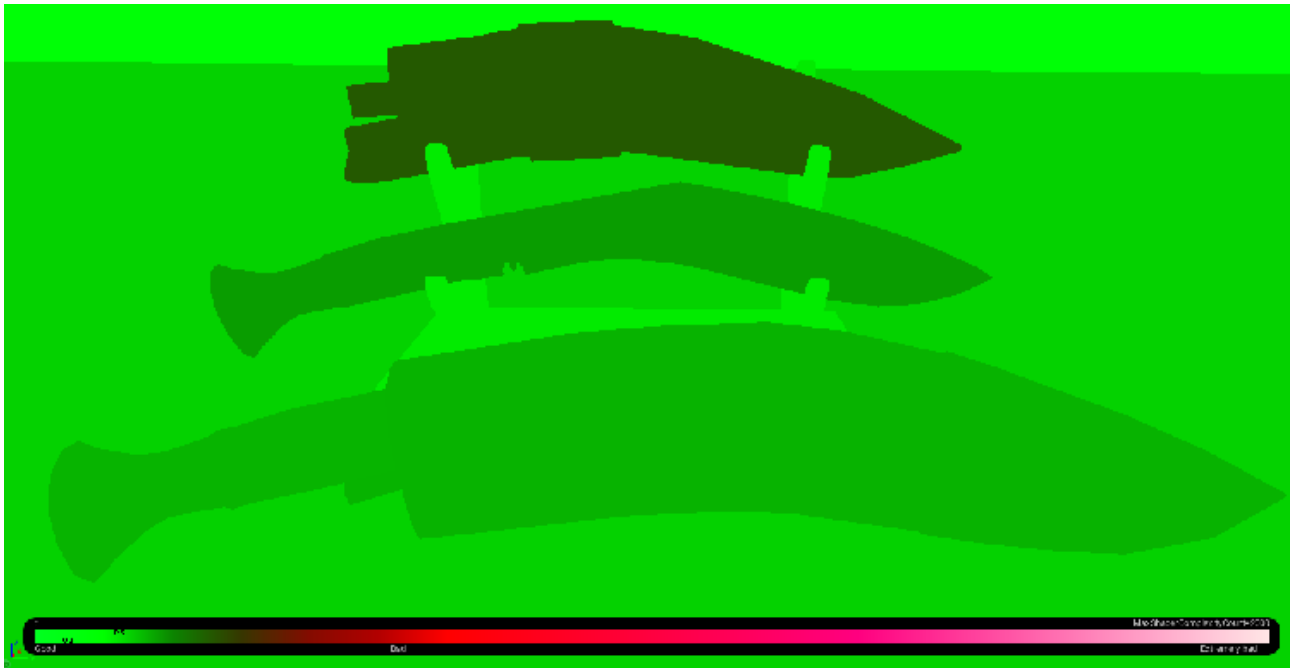
Baking Materials for Khukuri

Baking materials allows to reduce the shader complexity and texture memory used depending on the material. This document assumes you are familiar with using the UE4 Editor.

Let's bake the materials for the assets below from the Khukuri set as an example: one leather sheath, one solo knife and one knife inserted into a silver sheath fixed combo.



Shader complexity for these looks as follows using the standard materials with all their parameter variations:

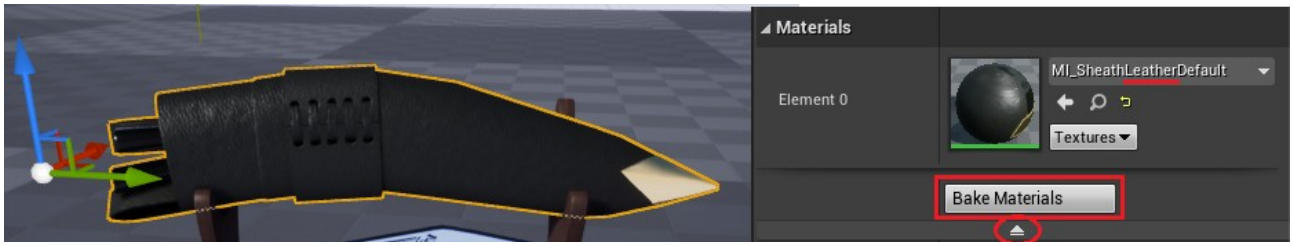


The following table shows, which texture types have to be baked for each type of mesh:

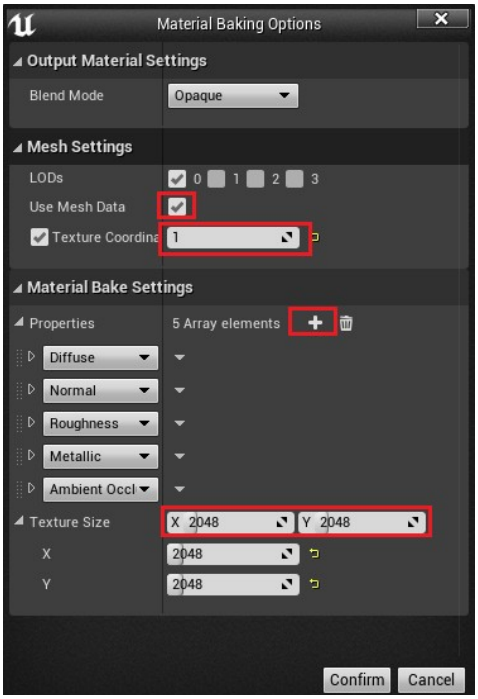
Knife variant	Diffuse / Normal	Roughness	Metallic	Ambient Occlusion	Specular	Keyword for mat instance
Solo knife	X	G	B		R	Knife
Solo silver sheath	X	G	B			Silver
Solo leather sheath	X	G	B	R		Leather
Knife in silver sheath	X	G	B			Silver/Grip
Knife in leather sheath	X	G	B	R		Leather/Grip

If you want to use the python script to combine textures later on, you need to use material instances starting with prefix *MI_* and include the correct *keywords* into the material instance names, see table (case sensitive).

Going for the leather sheath. Select the asset and make sure to open the advanced settings in the details section.



Click the Bake Materials button and adjust the settings as follows:



Add array elements for all needed texture map types as found in the above table.

Then click *Confirm* to start the baking process. The baked assets are created in the content browser directory of the corresponding mesh, here the Sheath-Leather directory.

UE4 creates one texture[1] for each selected element and a material instance based on a master material found in Engine Content.

We might use this generated material instance immediately without any further action, making the material much cheaper, but still using 5 texture slots.

We can go even further to an absolute minimum material and by combining textures like roughness and metallic into one single texture by using color channels, which is unfortunately not possible with the UE4 material baking process.

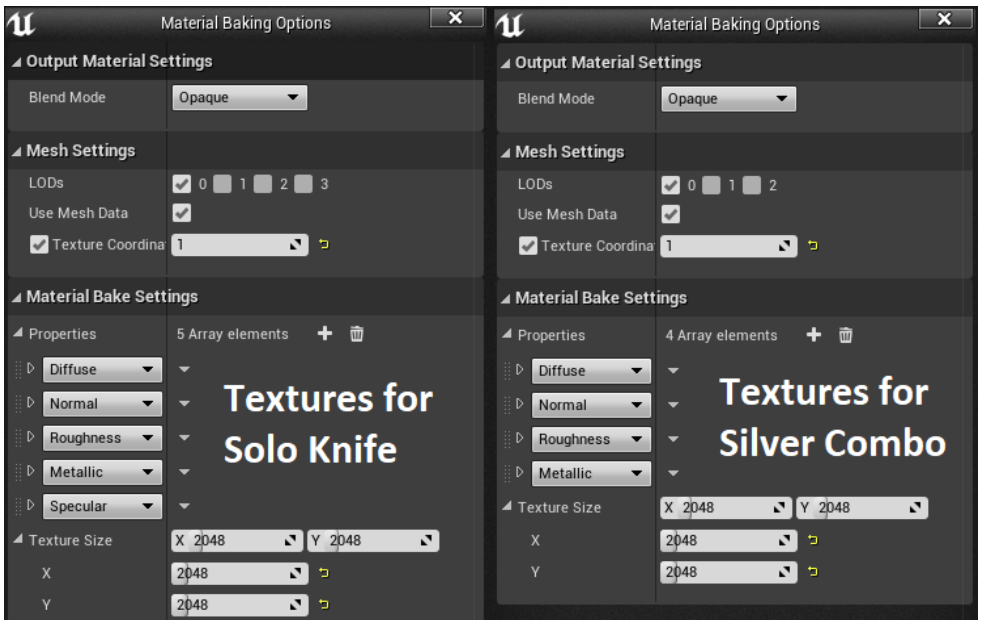
For this purpose, I have written a small python script, doing this texture joining for you. You need to have python installed (I use Python 3.7) along with the Pillow library.

The python script is available on Github: LINK

Copy the python script into a directory of your choice. Add a subdirectory named "Work" and export the 5 textures into this working directory. These get exported as .TGA files.

The UE4 generated material instance and textures can be deleted from content browser, if you do not plan to use them further.

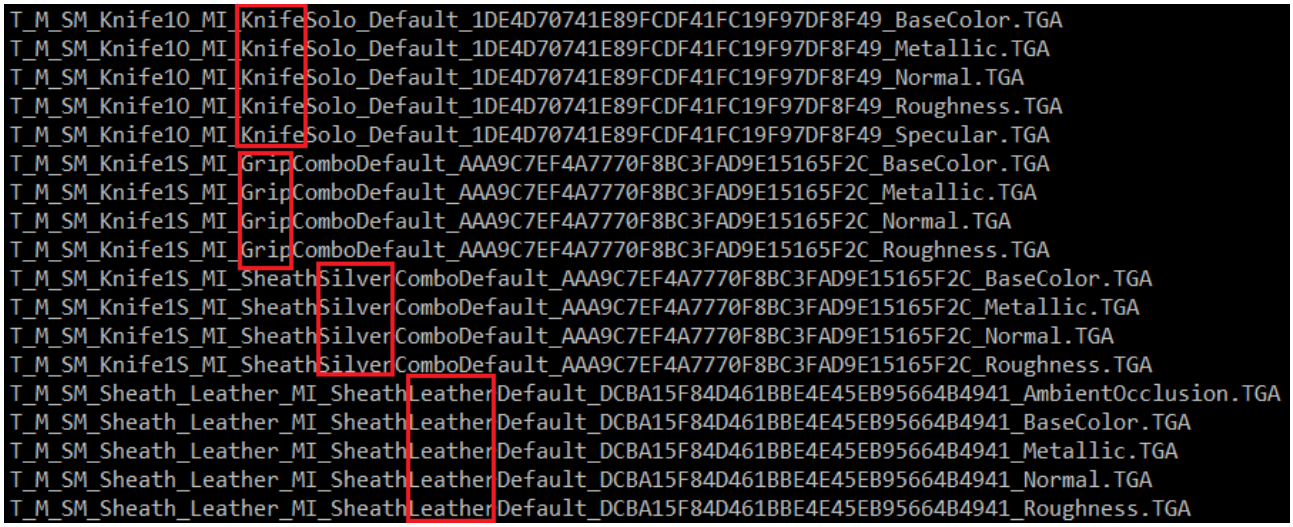
Next, repeat these steps for the Solo Knife and the Knife in Silver Sheath combined mesh from this example. Check the table to see that the solo knife uses Specular (actually only used, if blood has been applied to the knife) and the Knife/Silver Sheath combination only uses roughness and metallic. These are the settings:



Also note, that the Silver Sheath with Knife combo has 2 material slots (one for the sheath part and one for the grip, so separate textures get baked)[2]

1 Note, that the UE4 baked textures use sRGB - even for textures like roughness.
2 I even had a version of the script joining these into one single material slot to be used with a single material mesh instance - but this resulted in problems with normal maps - so this got dropped.

The work directory now contains all textures that have been exported. Note the keywords, that have been included into the names of the material instances:



Now simply run the python script, which looks as shown below, here doing it with calling the python executable directly.

```
E:\_Projects\Blender\Khukuri\TexJoiner>e:\Python\python.exe TexJoiner.py

Processing Texture _MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49
Processing Work/T_M_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_BaseColor.TGA (BaseColor)
Saving BaseColor to Work/T_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_D.png
Processing Work/T_M_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_Metallic.TGA (Metallic)
Processing Work/T_M_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_Normal.TGA (Normal)
Saving Normal to Work/T_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_N.png
Processing Work/T_M_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_Roughness.TGA (Roughness)
Resizing _MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49 - Roughness
Processing Work/T_M_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_Specular.TGA (Specular)
Resizing _MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49 - Specular
Saving MRS map to Work/T_SM_Knife1O_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_MRS.png

Processing Texture _MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C
Processing Work/T_M_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_BaseColor.TGA (BaseColor)
Saving BaseColor to Work/T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_D.png
Processing Work/T_M_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Metallic.TGA (Metallic)
Processing Work/T_M_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Normal.TGA (Normal)
Saving Normal to Work/T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_N.png
Processing Work/T_M_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Roughness.TGA (Roughness)
Resizing _MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C - Roughness
Saving MR map to Work/T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_MR.png

Processing Texture _MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C
Processing Work/T_M_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_BaseColor.TGA (BaseColor)
Saving BaseColor to Work/T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_D.png
Processing Work/T_M_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Metallic.TGA (Metallic)
Processing Work/T_M_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Normal.TGA (Normal)
Saving Normal to Work/T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_N.png
Processing Work/T_M_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_Roughness.TGA (Roughness)
Saving MR map to Work/T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_MR.png

Processing Texture _MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941
Processing Work/T_M_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_AmbientOcclusion.TGA
(AmbientOcclusion)
Processing Work/T_M_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_BaseColor.TGA (BaseColor)
Saving BaseColor to Work/T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_D.png
Processing Work/T_M_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_Metallic.TGA (Metallic)
Processing Work/T_M_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_Normal.TGA (Normal)
Saving Normal to Work/T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_N.png
Processing Work/T_M_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_Roughness.TGA (Roughness)
Saving OMR map to Work/T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_OMR.png

E:\_Projects\Blender\Khukuri\TexJoiner>
```

This creates a bunch of PNG texture files, which have combined roughness, metallic and AO/specular into color channels (see table).

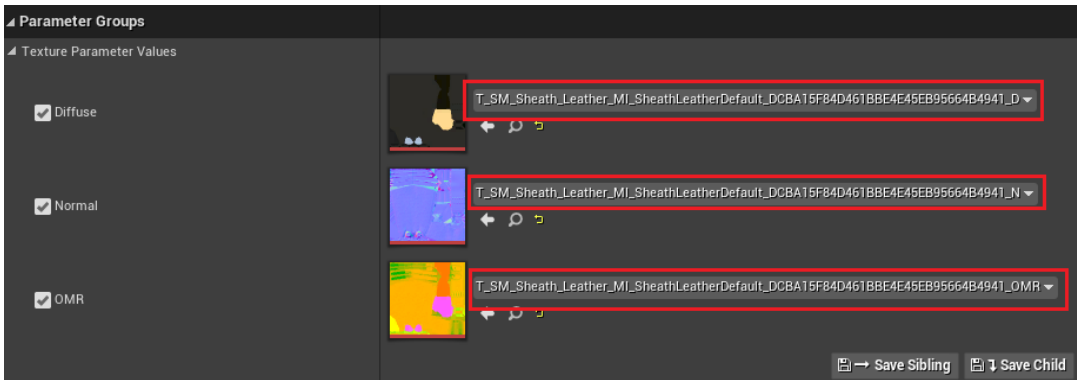
```
T_SM_Knife10_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_D.png
T_SM_Knife10_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_MRS.png
T_SM_Knife10_MI_KnifeSolo_Default_1DE4D70741E89FCDF41FC19F97DF8F49_N.png
T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_D.png
T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_MR.png
T_SM_Knife1S_MI_GripComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_N.png
T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_D.png
T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_MR.png
T_SM_Knife1S_MI_SheathSilverComboDefault_AAA9C7EF4A7770F8BC3FAD9E15165F2C_N.png
T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_D.png
T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_N.png
T_SM_Sheath_Leather_MI_SheathLeatherDefault_DCBA15F84D461BBE4E45EB95664B4941_OMR.png
```

Import these back into UE4 into your MaterialBaking folder:

Now create material instances for the meshes and select the correct parent material from the base materials found in the Materials/Bake folder. "Combo" is used for the Knife in Sheath mesh variants.

For the leather sheath we use M_SheathLeatherSolo_BAKE as parent.

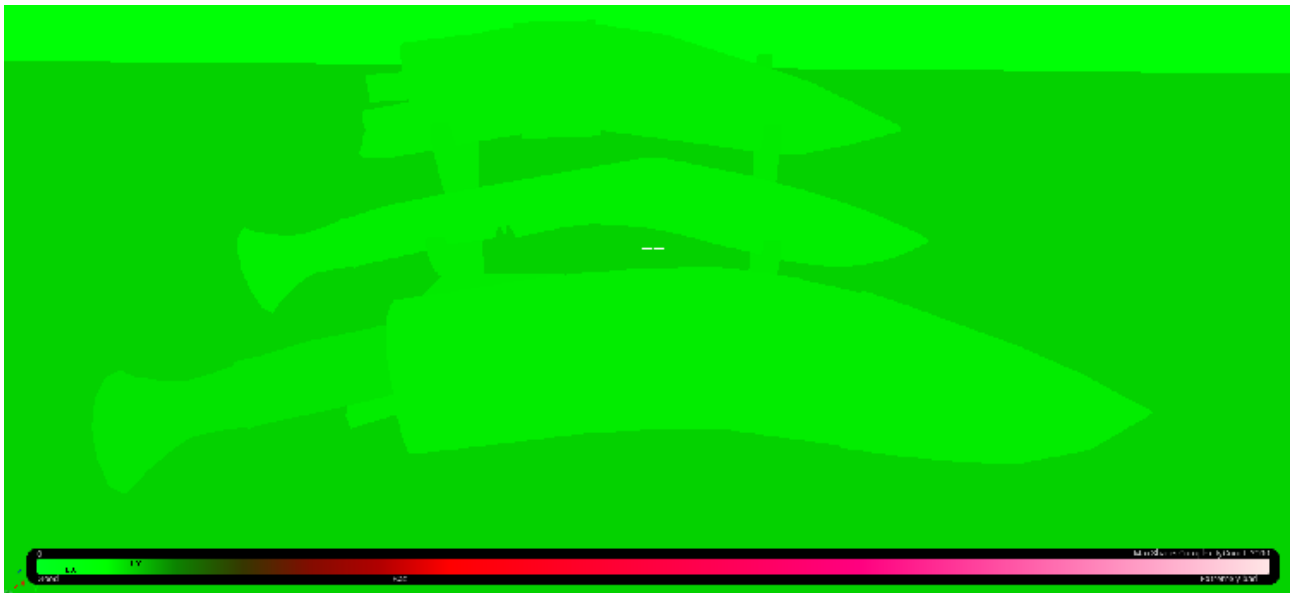
Choose the appropriate texture parameter values using the baked textures (starting with T_SM, if your static meshes follow the naming convention).



Do the same for the solo knife and the knife in sheath silver combination (2 material slots here)

Assign the material instances to the meshes.

There's should be no visual difference if everything has been assigned correctly, but the shader complexitity is now reduced to a minimum because our base material is the simplest possible.



In addition, by combining textures into color channels we also reduced the memory footprint to a minimum.