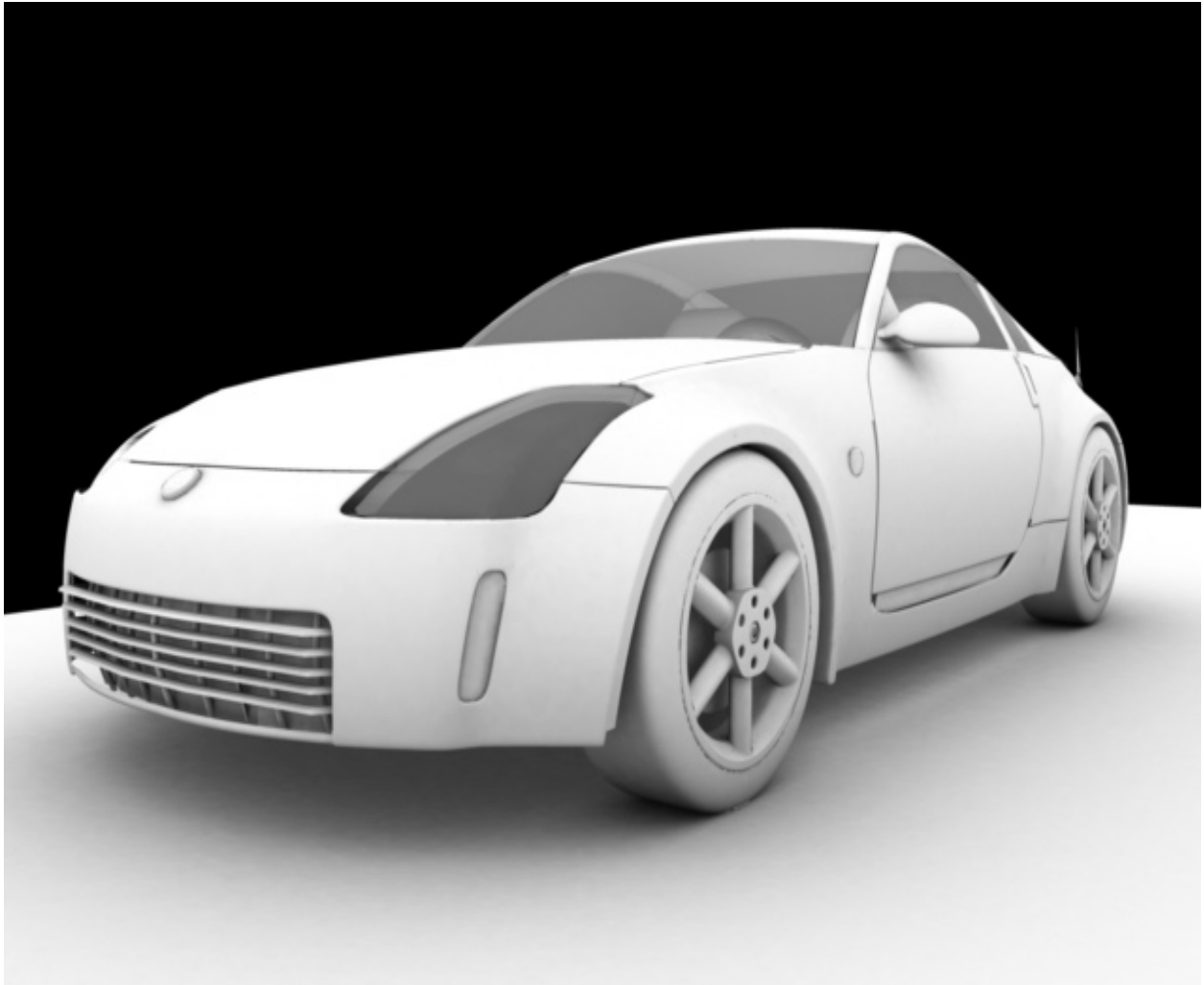


3.2 AMBIENT OCCLUSION



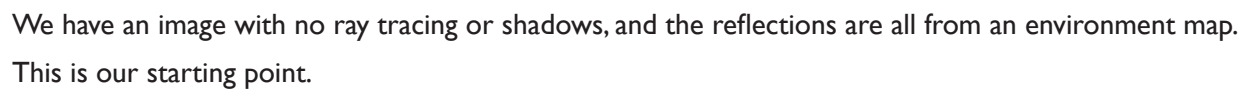
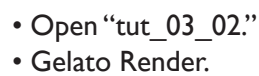
This is the companion to the movie, tut_03_02, part 2 of 8 NVIDIA® Gelato® Advanced Tutorials.

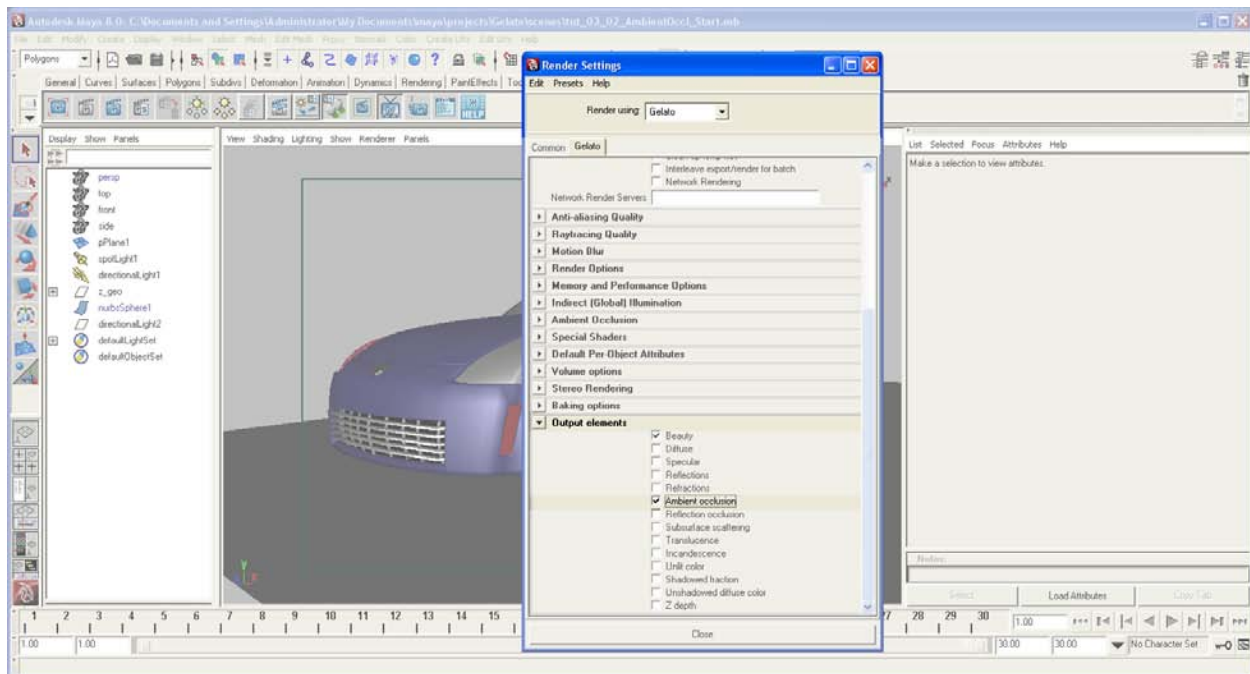
Ambient occlusion is a rendering technique or algorithm that determines what areas fall into shadow. This is an alternative or quicker way of shadow solving than using indirect illumination. It gives nice detail in cracks and crevices and nice contact shadows – things that would typically be more difficult to obtain with direct illumination or be very render costly through the use of indirect illumination.

Ambient occlusion works by bouncing rays around a scene to determine what's being occluded by what else. Some rays will hit surfaces and bounce around seams and cracks and other areas which won't allow them to escape, or escape easily, leaving these places in various levels of shadow; others will get bounced out into the 3D sky, indicating areas of no shadow. Because the ambient occlusion calculations depend upon these rays being able to bounce into the sky, it is important to note that when calculating this, there must be a sky in the 3D world. This couldn't be done if the objects were in an enclosed space.

We're also going to take a look at how Gelato interpolates, or subdivides, geometry at render time.

Gelato offers more than one method of doing ambient occlusion, so let's take a look...

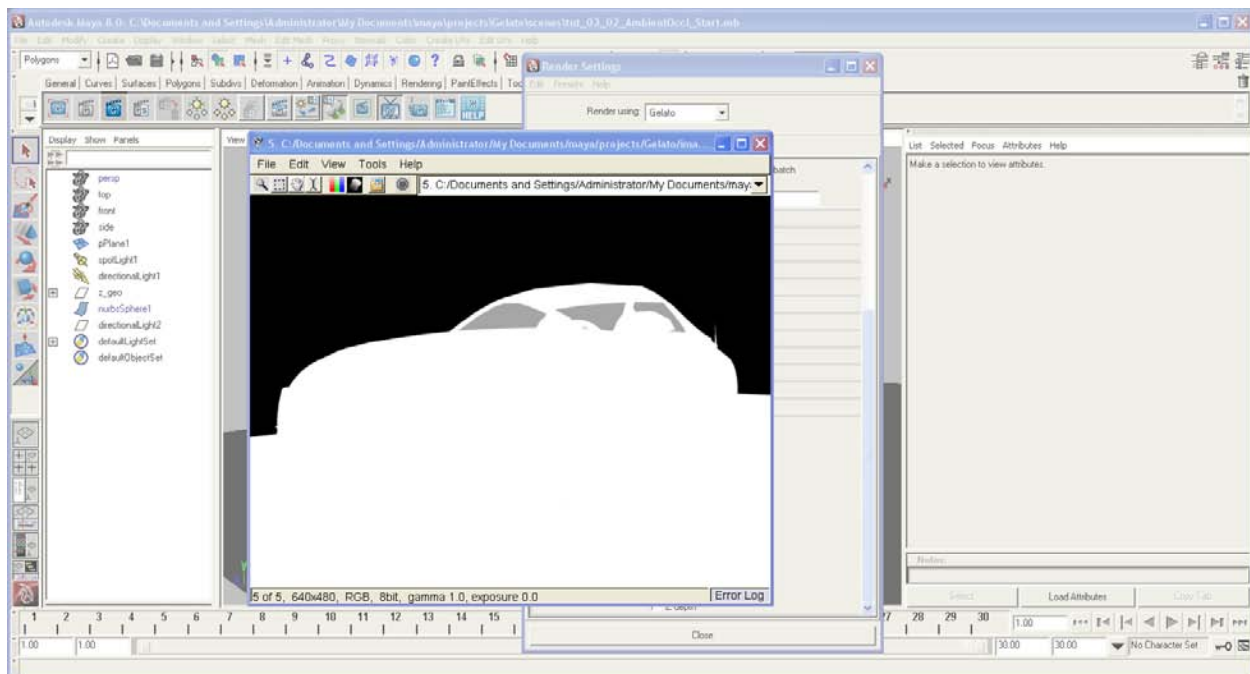




- Render Settings > Gelato > Output Elements* > enable Ambient Occlusion.

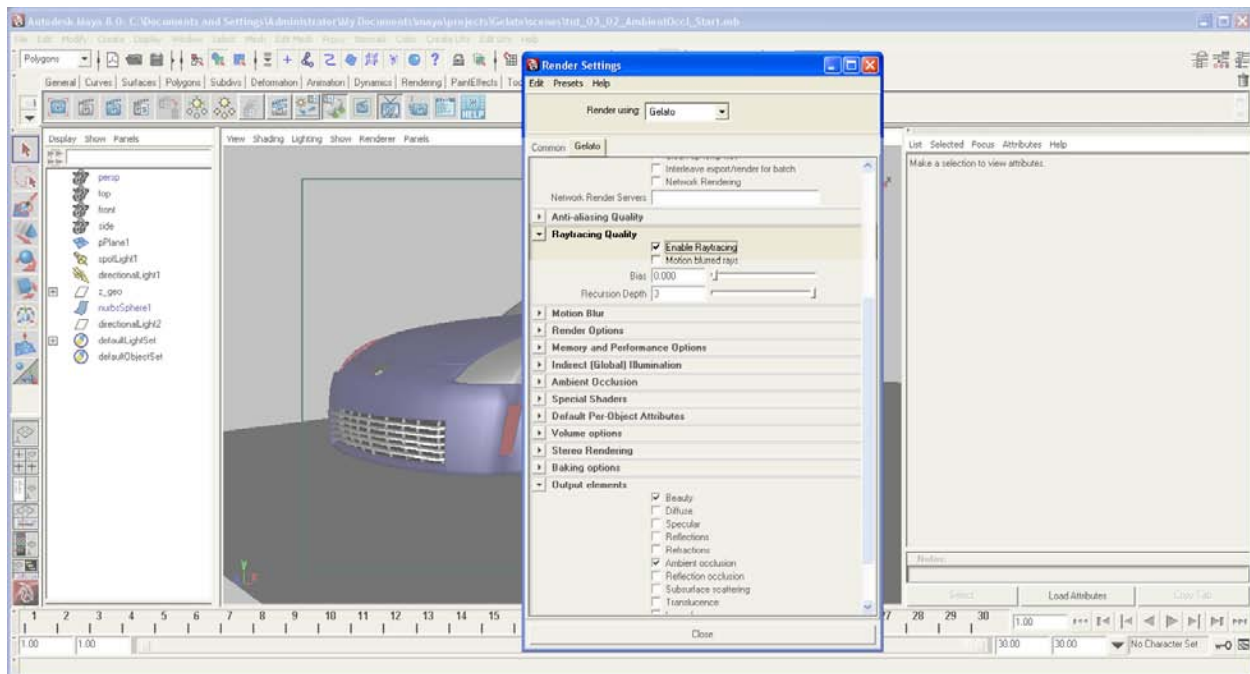
If you would like to speed up your rendering times, you may turn off the Beauty Pass. Compositors frequently require both for their compositing pipeline and in this example, we'll be leaving it on.

**We will be taking a closer look at this Output Elements section in a later tutorial.*

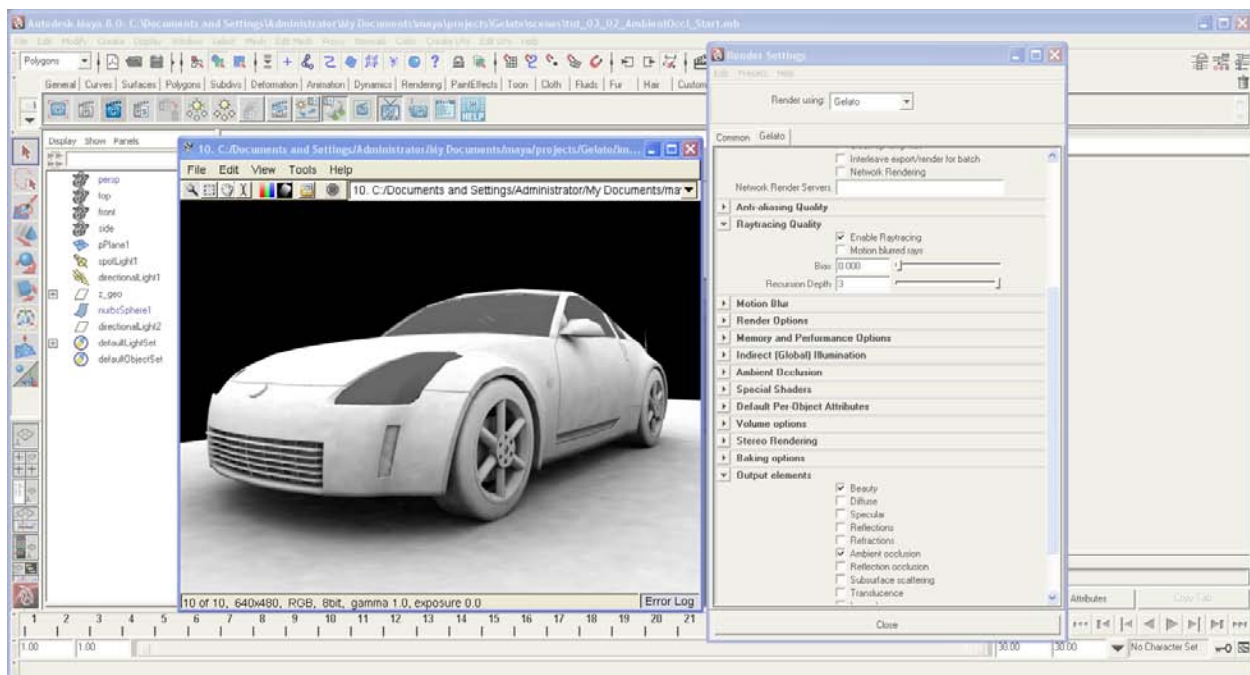


- Gelato Render.

Something happened, but this doesn't look very useful. The reason... ray tracing is not enabled. This is necessary to calculate the occlusion.

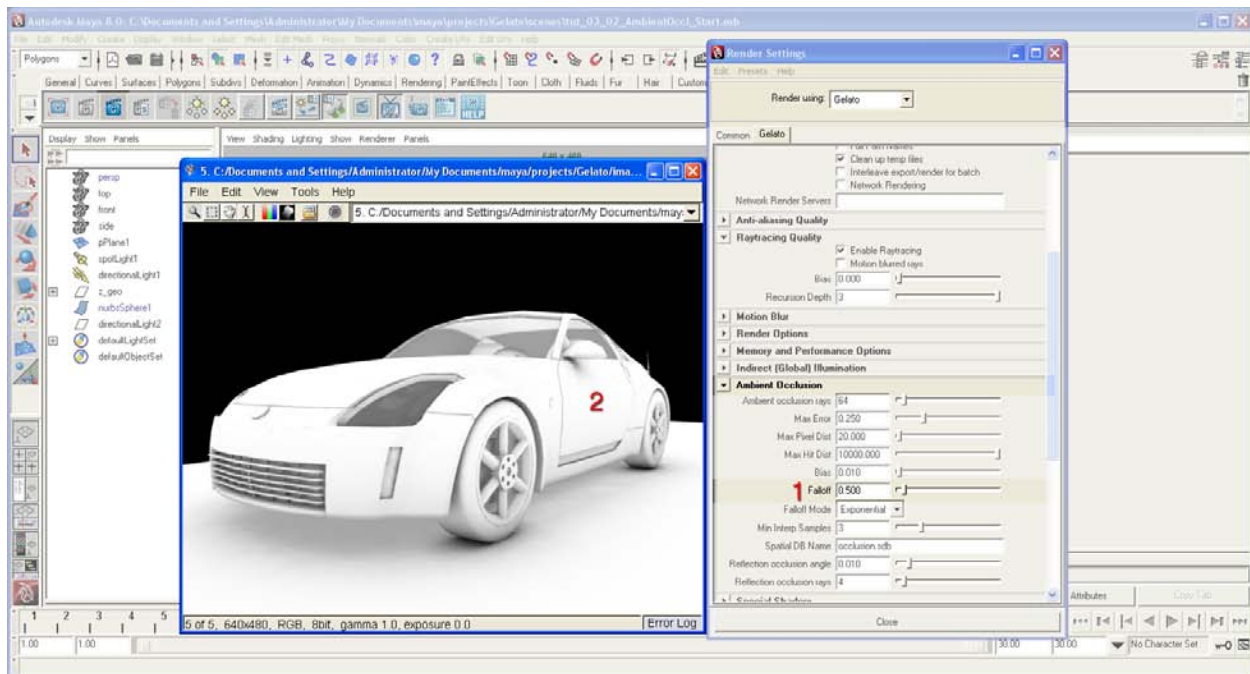


- Render Settings > Gelato > Raytracing Quality > Enable Raytracing.



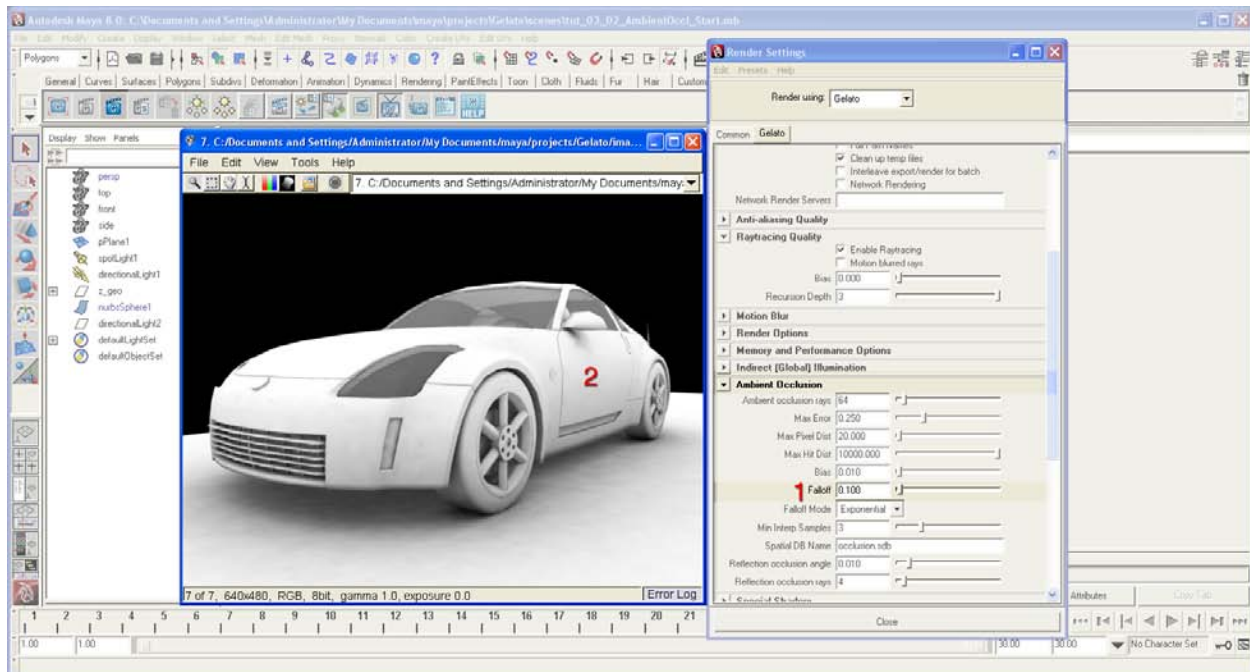
- Gelato Render.

- * The scene is dirtied up.
- * All the creases and seams of panels out of which the light can't really bounce are getting shaded.
- * There are a lot of artifacts in the scene that we are now going to address.



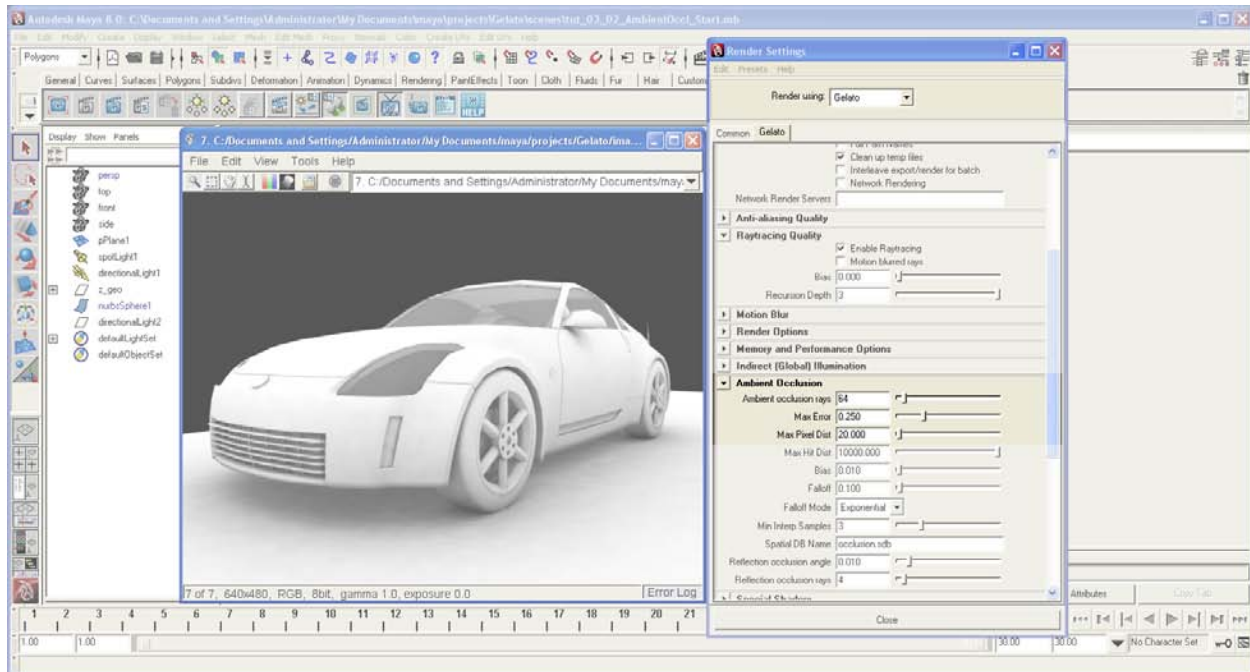
- Render Settings > Gelato > Ambient Occlusion > change Falloff to 0.500.
- Gelato Render.

The occlusion has been tightened up. This would be appropriate if we just wanted the seams and the contact shadows.



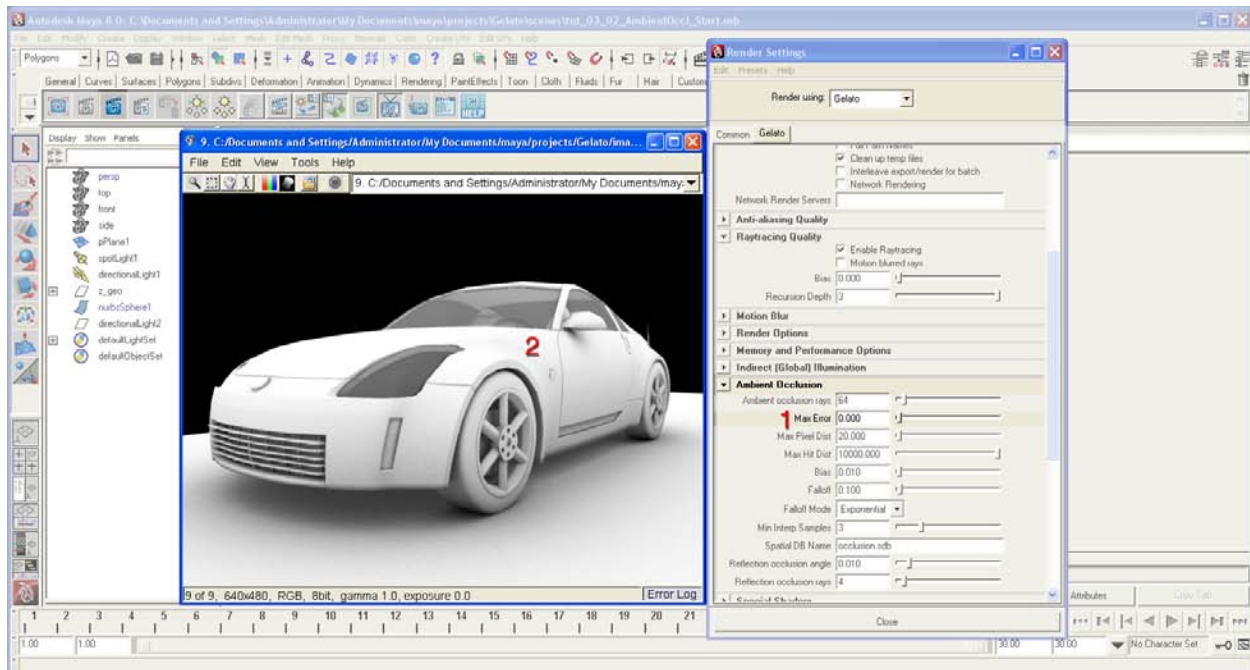
- Render Settings > Gelato > Ambient Occlusion > change Falloff to 0.100.
- Gelato Render.

We can still see the contact shadow, but now the shadow under the car is much more visible. The artifacts are more visible, but that's ok – we'll work now on filtering these out.



There are 3 settings that we will focus on to fine-tune this image: **Ambient occlusion rays**
Max Error
Max Pixel Dist

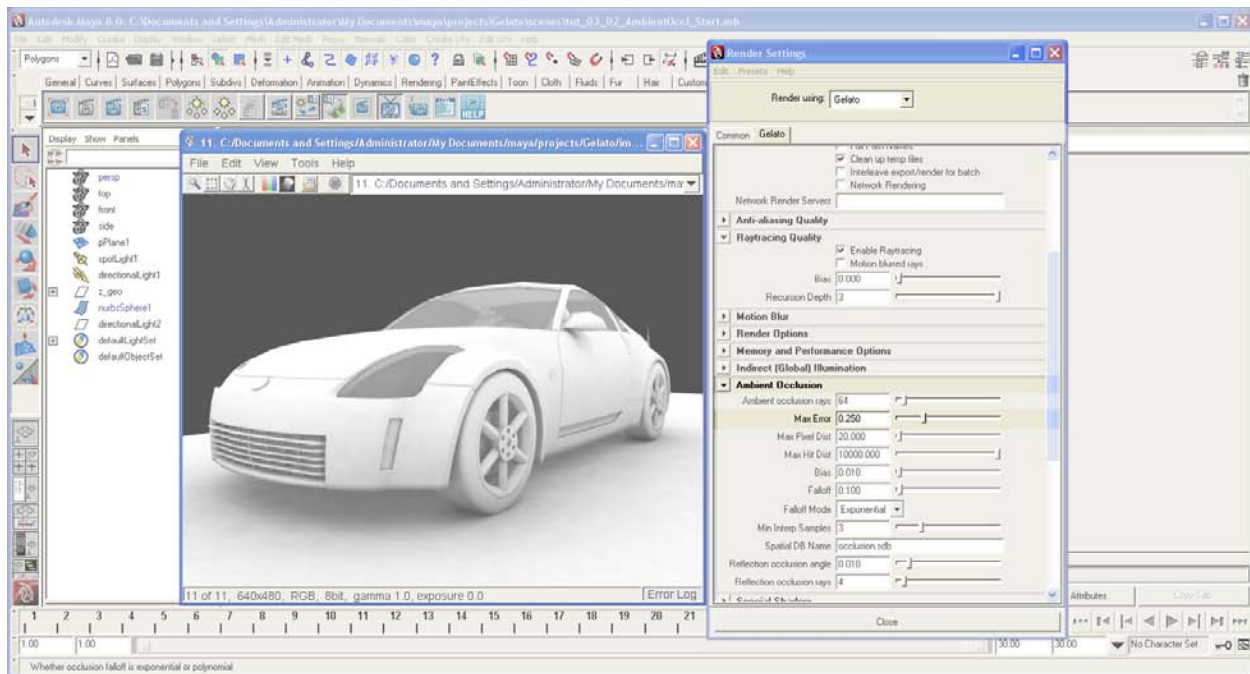
These 3 attributes are common throughout Gelato and as we move through these tutorials, will encounter them over and over again as we work to reduce artifacts.



Max Error is the number of points that are sampled in the ray tracing. If this were set to 0, this would sample every single point with 64 samples.

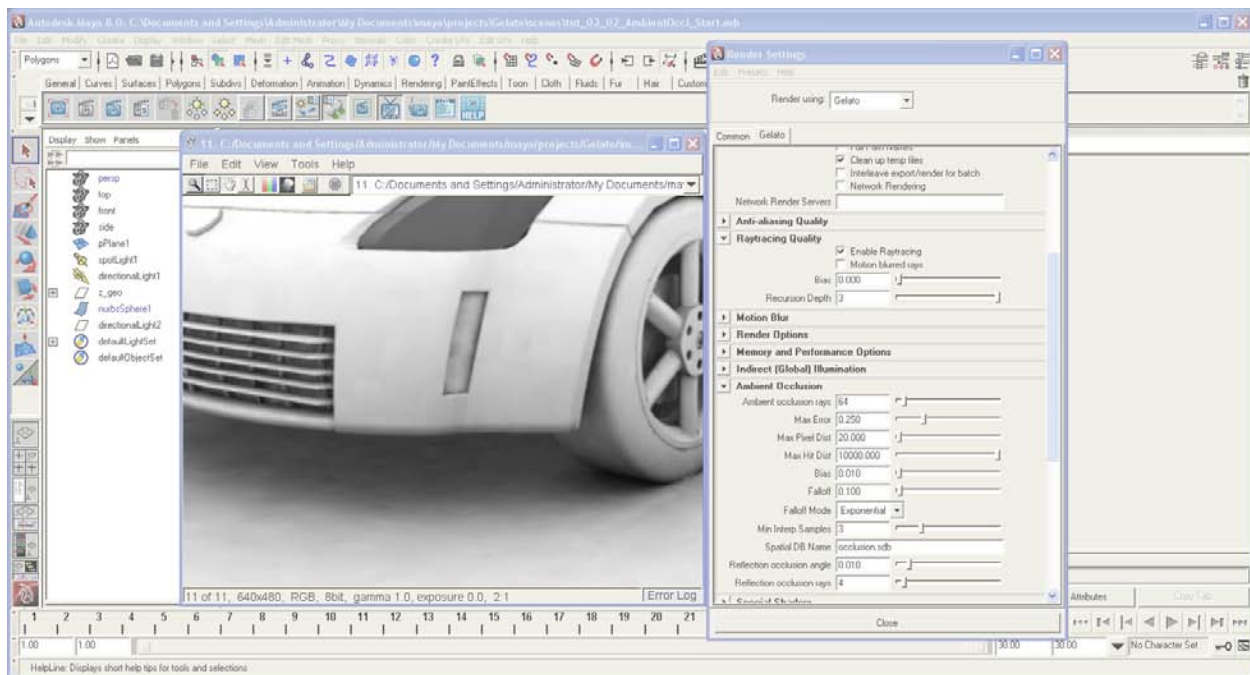
- Gelato Render.

There is still some noise. To get rid of this we would need to up the Ambient Occlusion Rays.

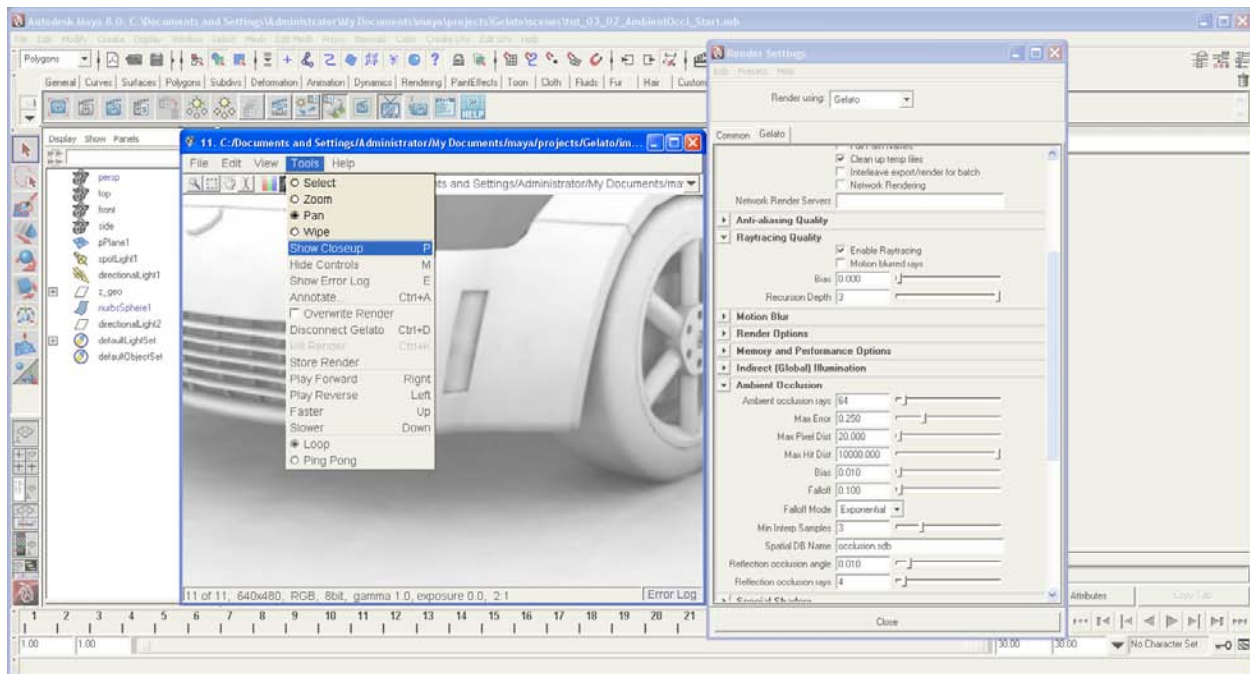


- Change the Max Error back to 0.250.

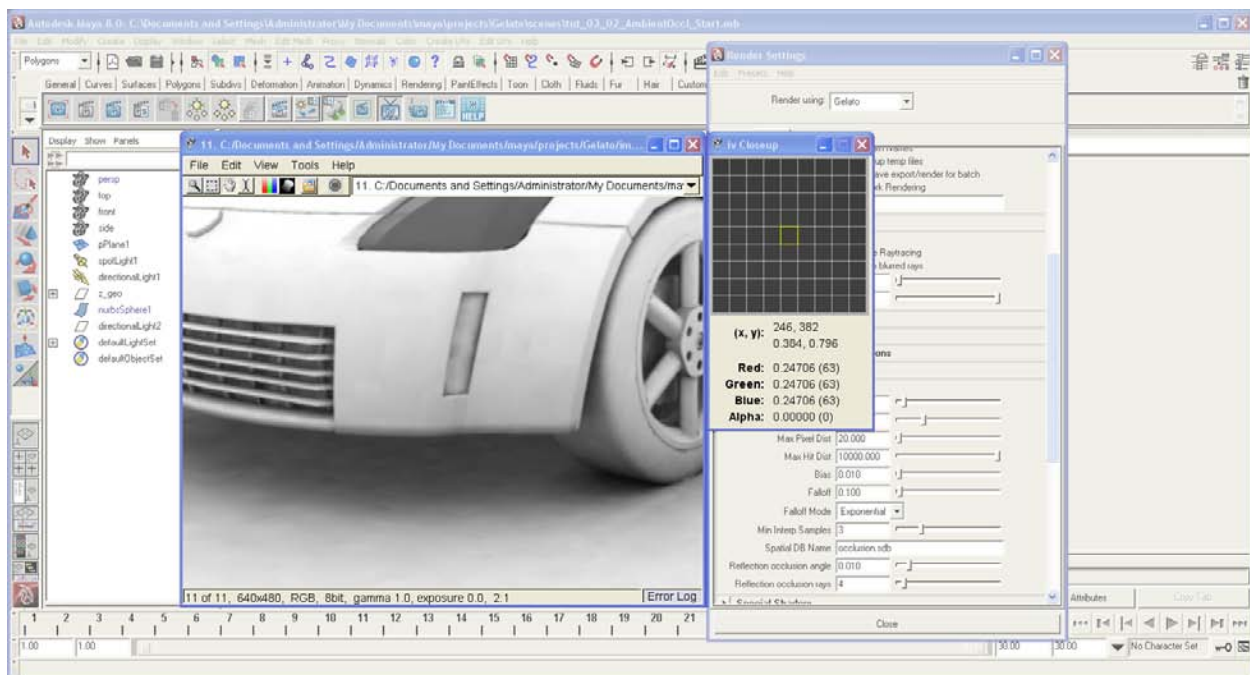
Sampling every point is costly with regards to render time, so we are going to interpolate. We'll use the Max Pixel Distance to help tune out the artifacts.



- Gelato Render.
- Zoom in to take a closer look (1st icon in the iv button bar).



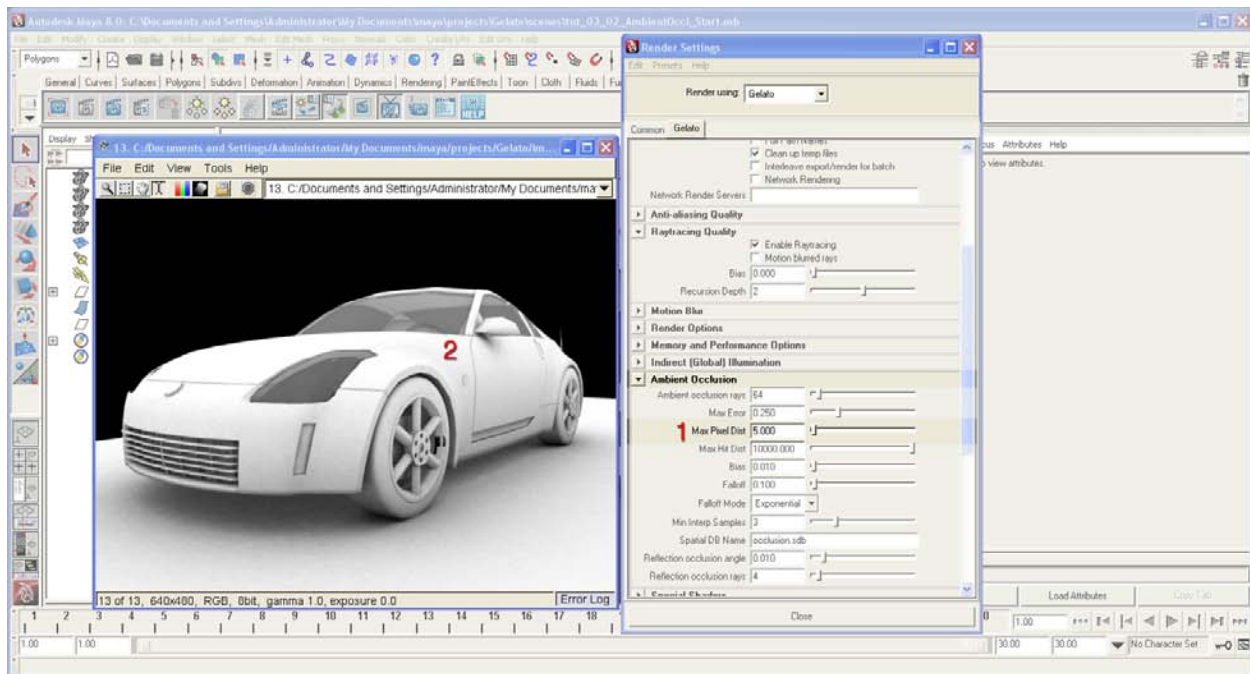
- Image Viewer > Tools > Show Closeup.



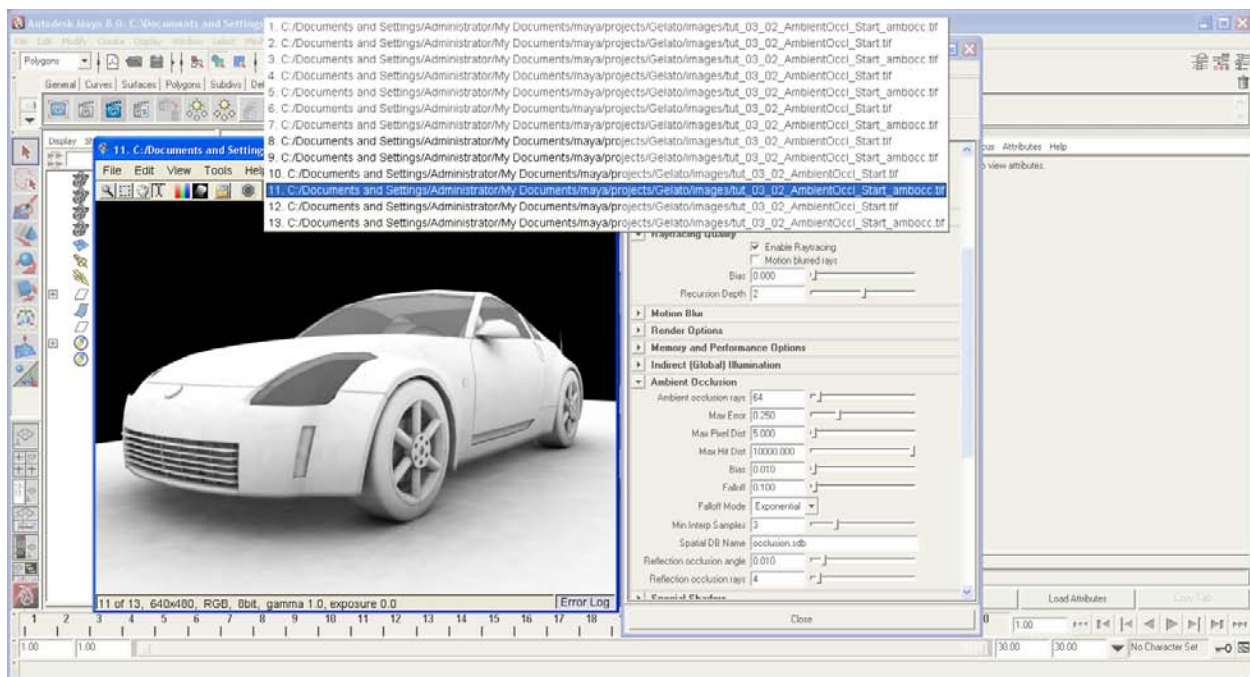
This invokes the iv Closeup window. Where the cursor is resting in the image is the area that is shown in the iv Closeup.

If we measure the length of one of the artifact blotches using this window, we see that it is about 20 pixels. This is the current Max Pixel Dist.

Max Pixel Dist is the pixel distance between the sampled points and is a very useful tool when optimizing an image.



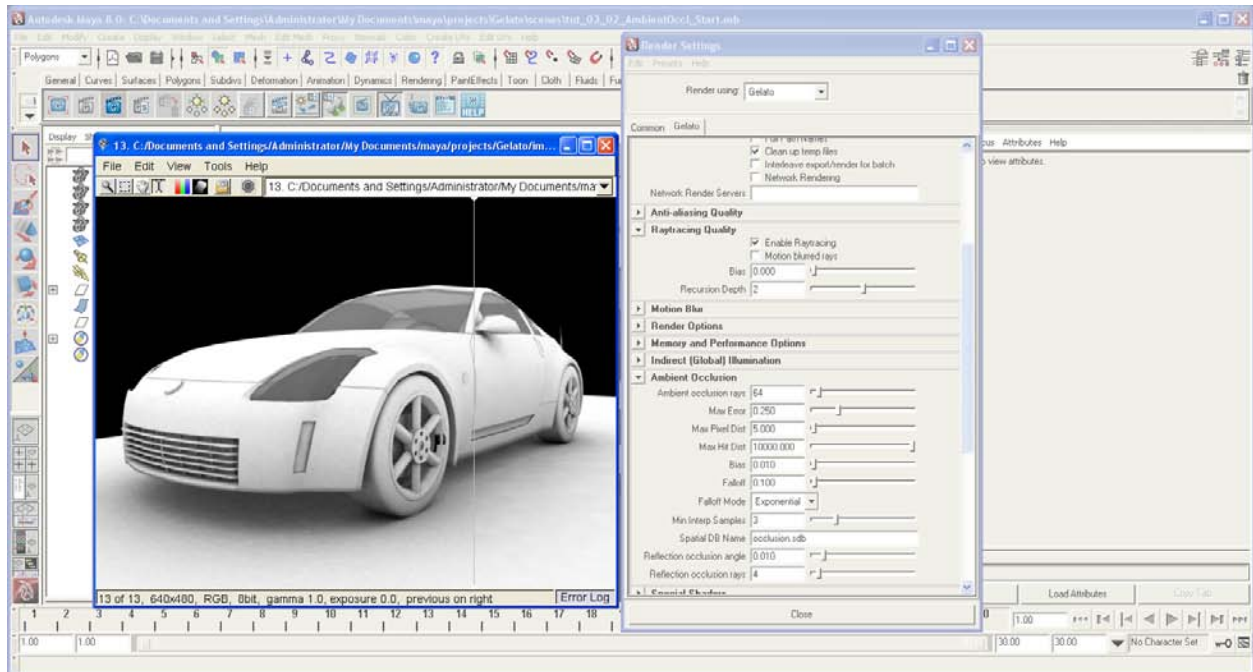
- Change the Max Pixel Dist to 5,000.
- Gelato Render.



It would be nice to compare this occlusion pass to the last one. If you left the beauty pass enabled and were to use the Wipe Tool now, you would Wipe between the occlusion pass and the beauty pass. To be able to compare this occlusion pass render to the last...

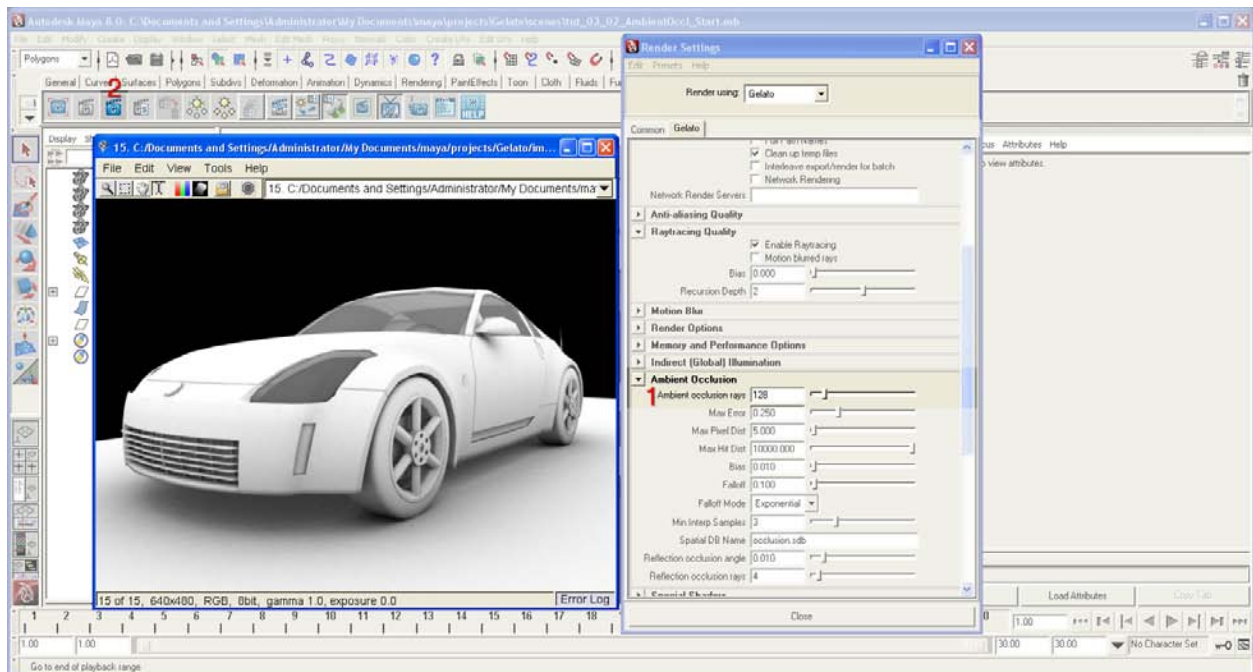
- Image Viewer > Document field > select the last occlusion pass (two passes up in the stack from the current render).
- Image Viewer > Document field > select most recent render to put our most recent render back in front.

Now when we use the Wipe tool, the previous occlusion pass will be below the most recent pass.



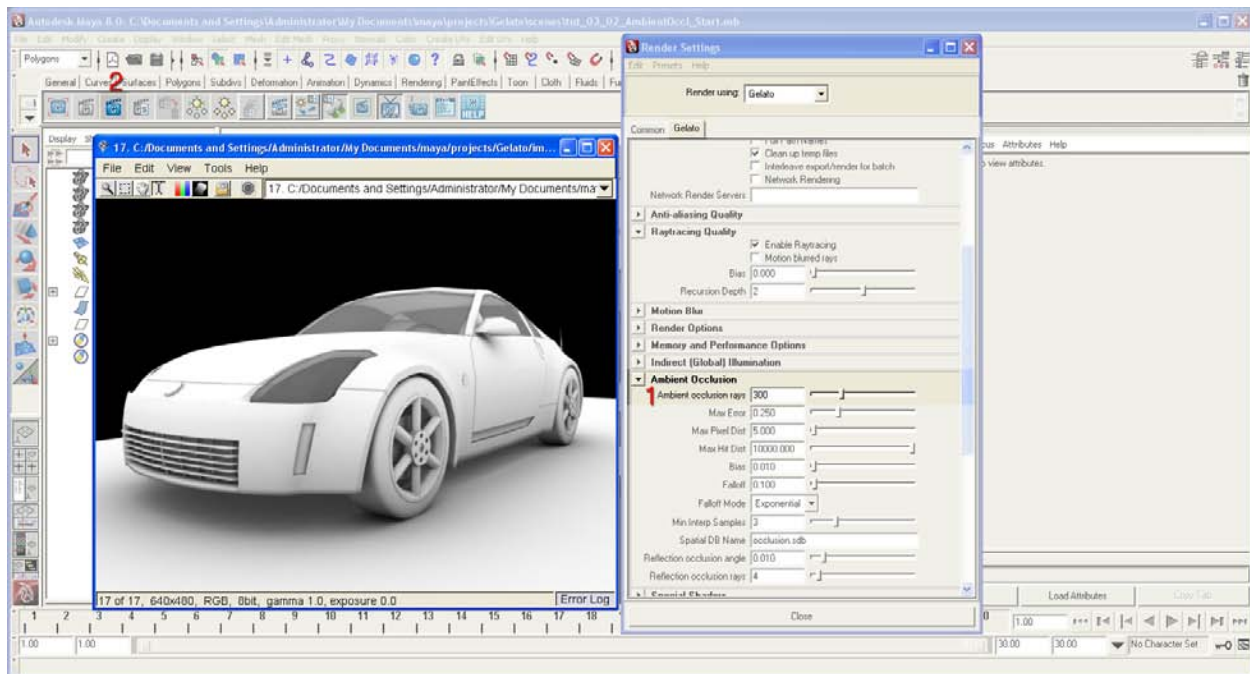
- Use the Wipe tool to compare this render to the last.

We can see that the artifacts look much smaller now. If we were to use the iv Closeup, we would see that the artifacts now are about 5 pixels wide. Things look much better.



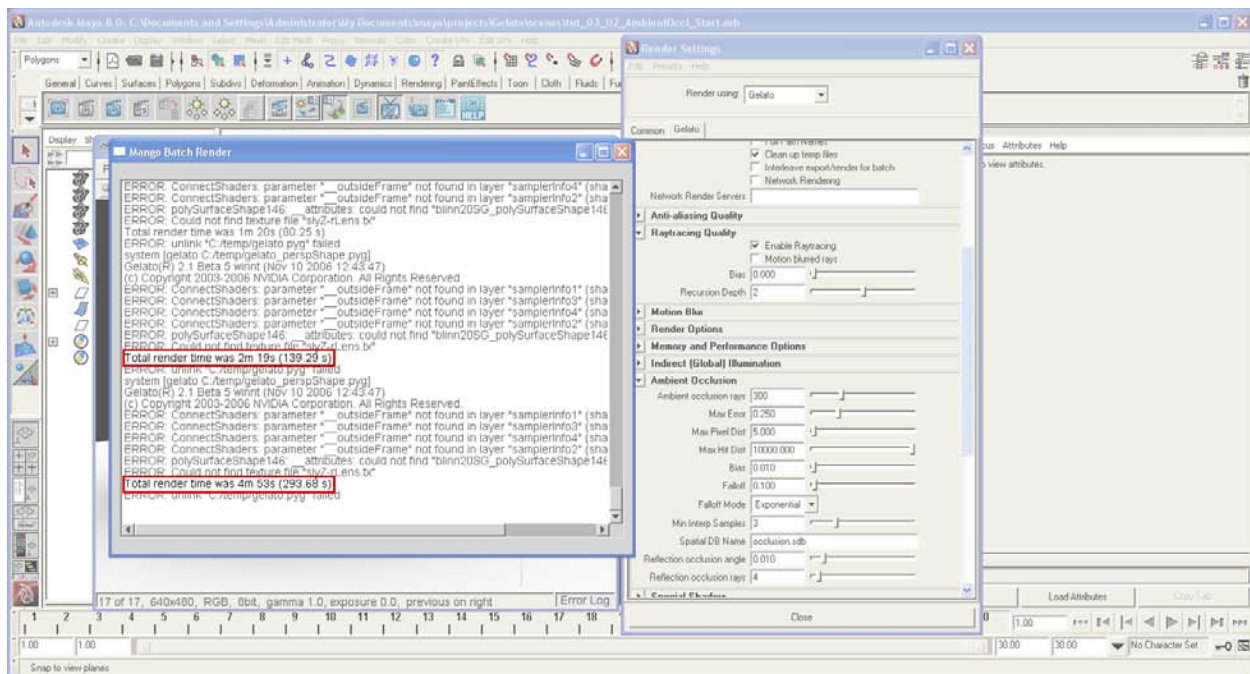
- Change the Ambient occlusion rays to 128.
- Gelato Render.

The artifact situation is improving – in some areas they are barely noticeable.



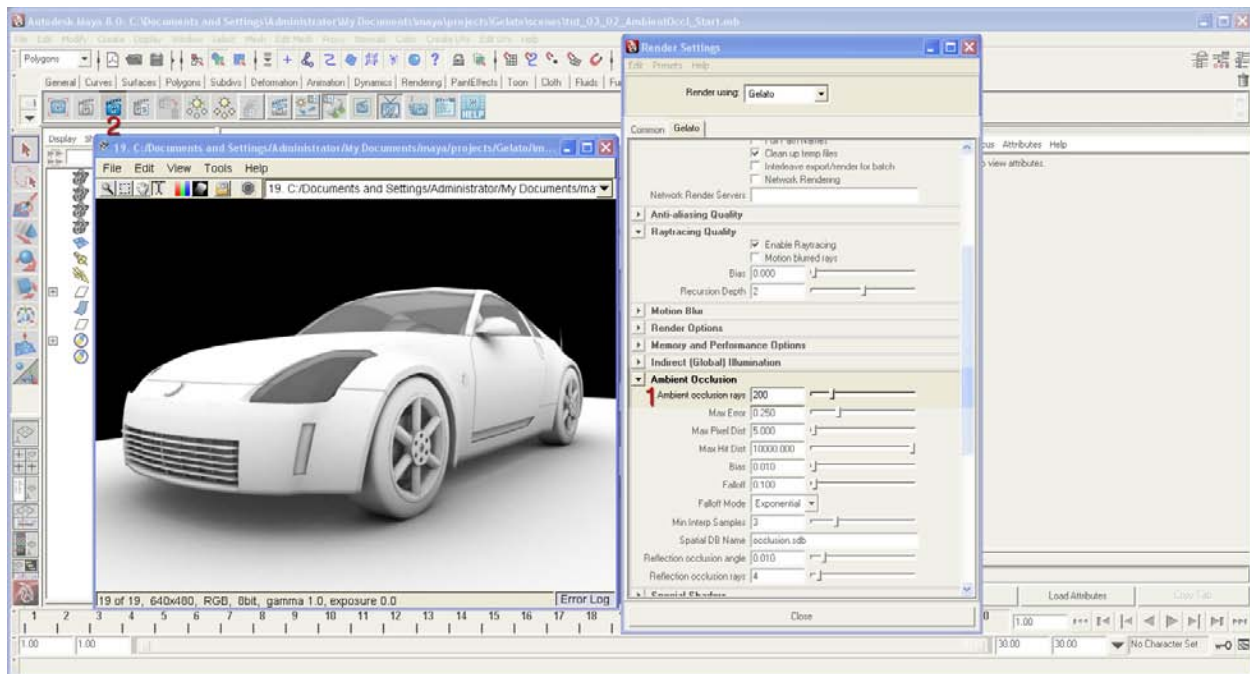
- Change the Ambient occlusion rays to 300.
- Gelato Render.

The artifacts are, for all intents and purposes, eliminated. The question becomes: is the increased render time worth it?



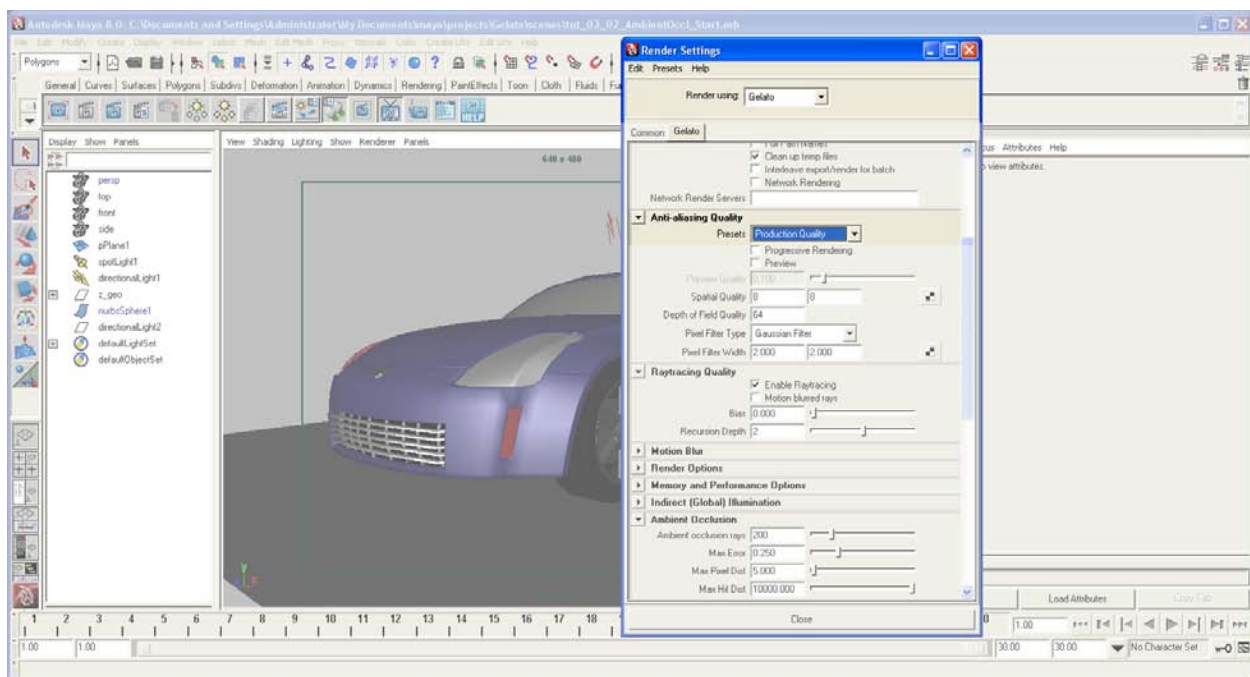
- **[CLK]** the Log button, second from the right in the Gelato Shelf.
- Compare the most recent render time to the last.

In the example above, the render time is about double. This may or may not work for your production.



- Change the Ambient occlusion rays to 200.

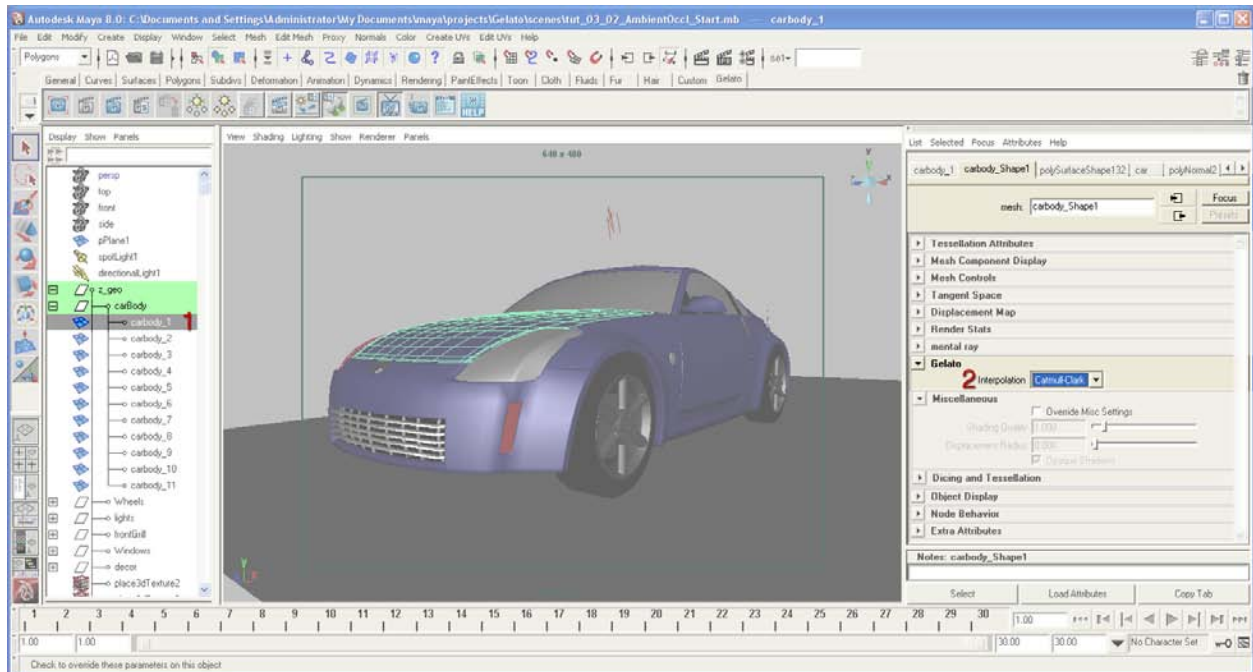
This will likely be close enough, a happy medium between more than enough and not enough.



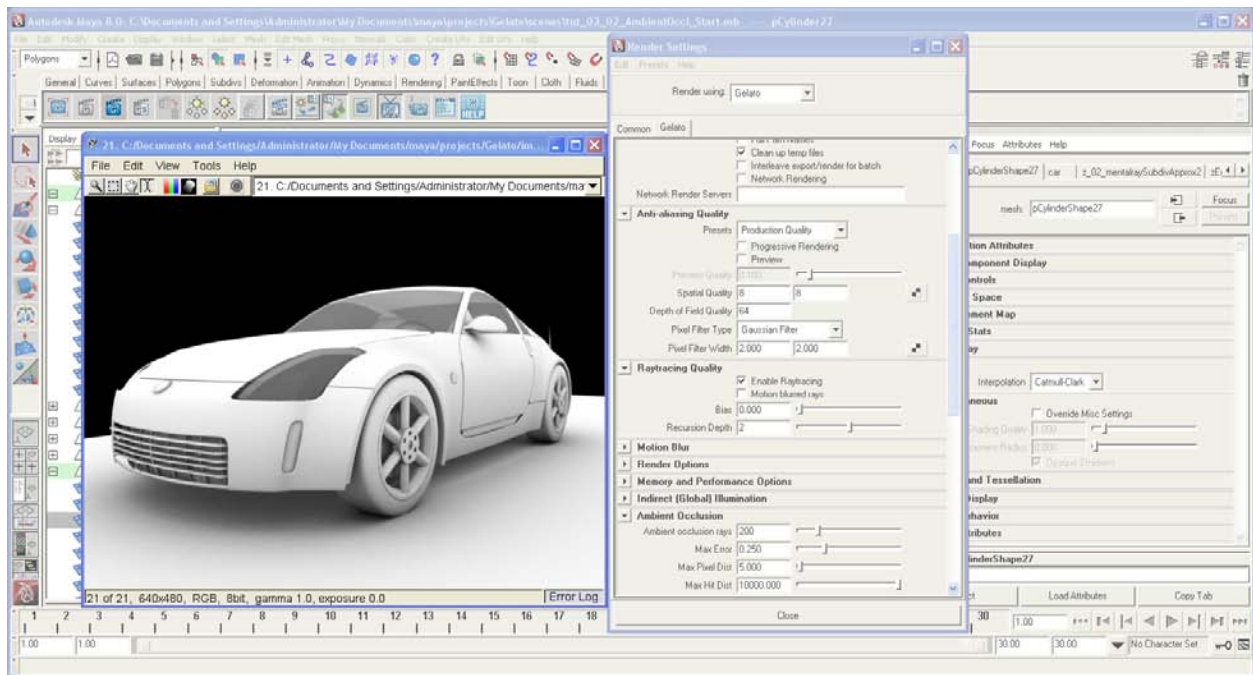
- Render Settings > Anti-aliasing Quality > presets > Production Quality

This will get rid of the noise around the crevices and the seams.

We can see the polygon outlines in the car model. The car was modeled with the intention that it be subdivided later. A beautiful feature offered by Gelato is the ability to interpolate the model at render time. Instead of needing to swap out a low-res proxy with a high-res model, we merely need to switch Interpolation type.

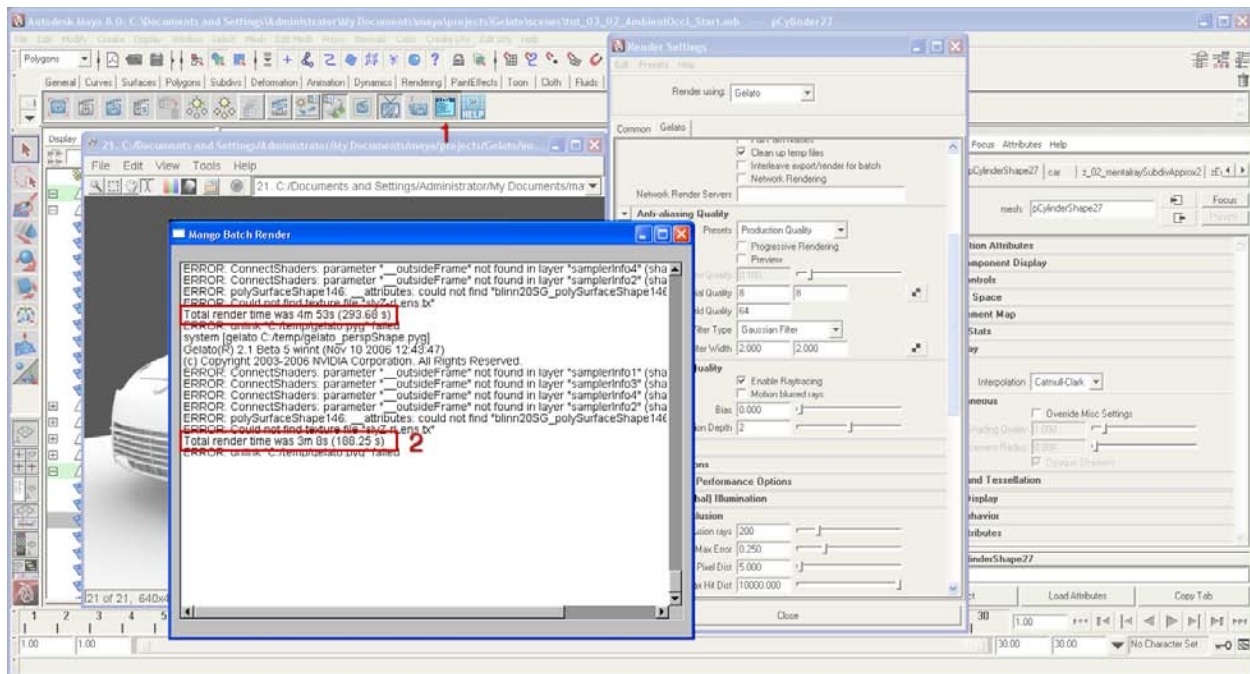


- Outliner > z_geo > carBody > carBody_1 > Attribute Editor > Gelato > Interpolation > Catmull-Clark
Repeat this for each of the carBody pieces and for the first three children of “decor.”



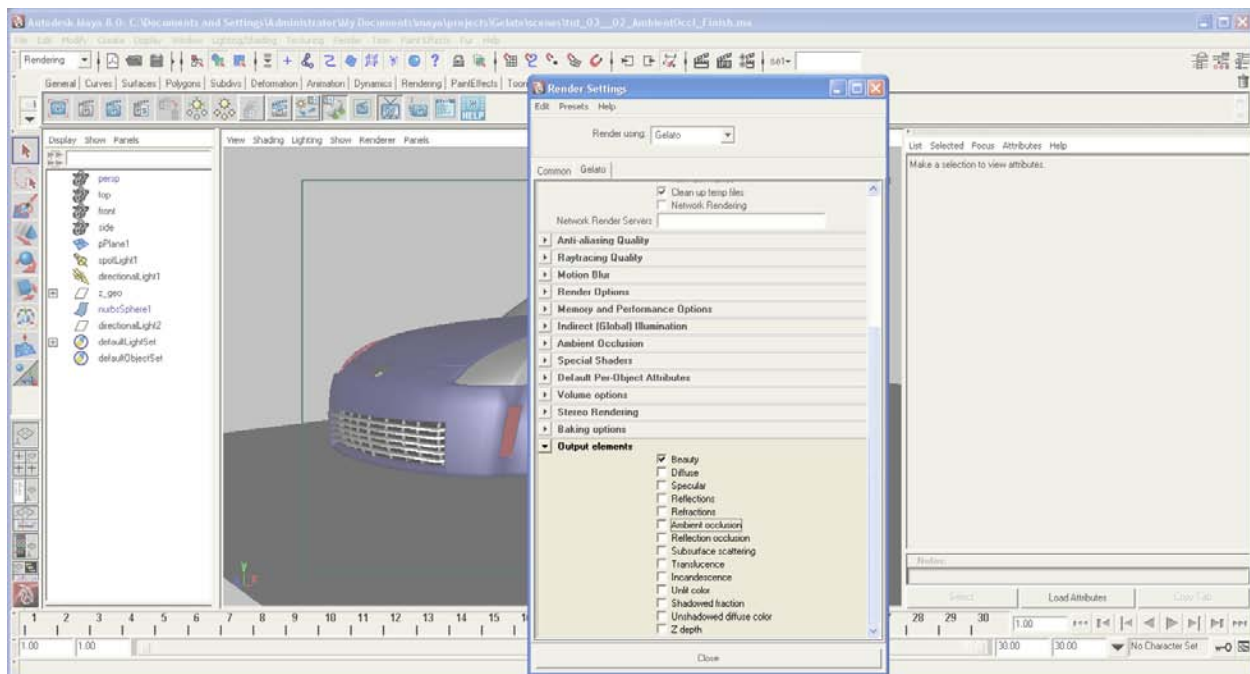
- Gelato Render.

A crisp, clean, smooth result. The Ambient occlusion rays value of 200 is working.



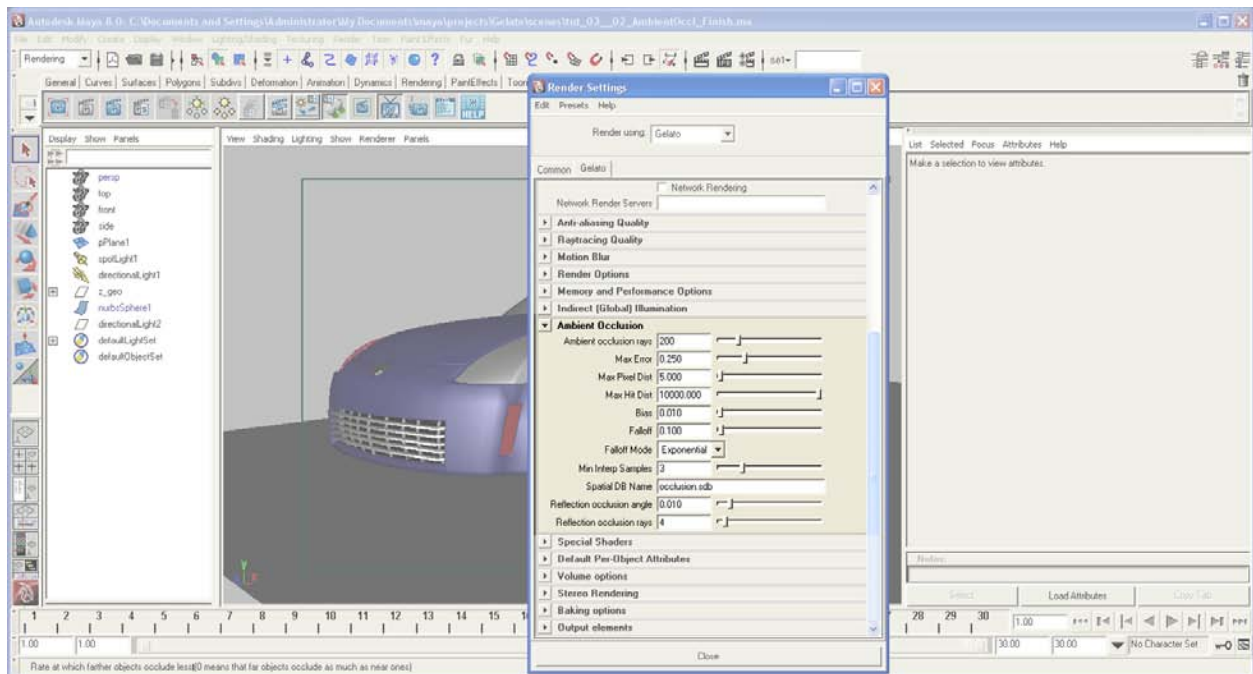
- Gelato Log > Mango Batch Render window.
- Compare this render time to the last.

The time saving is significant; any remaining artifacting, insignificant. And this was with increasing the geometry and upping the anti-aliasing!

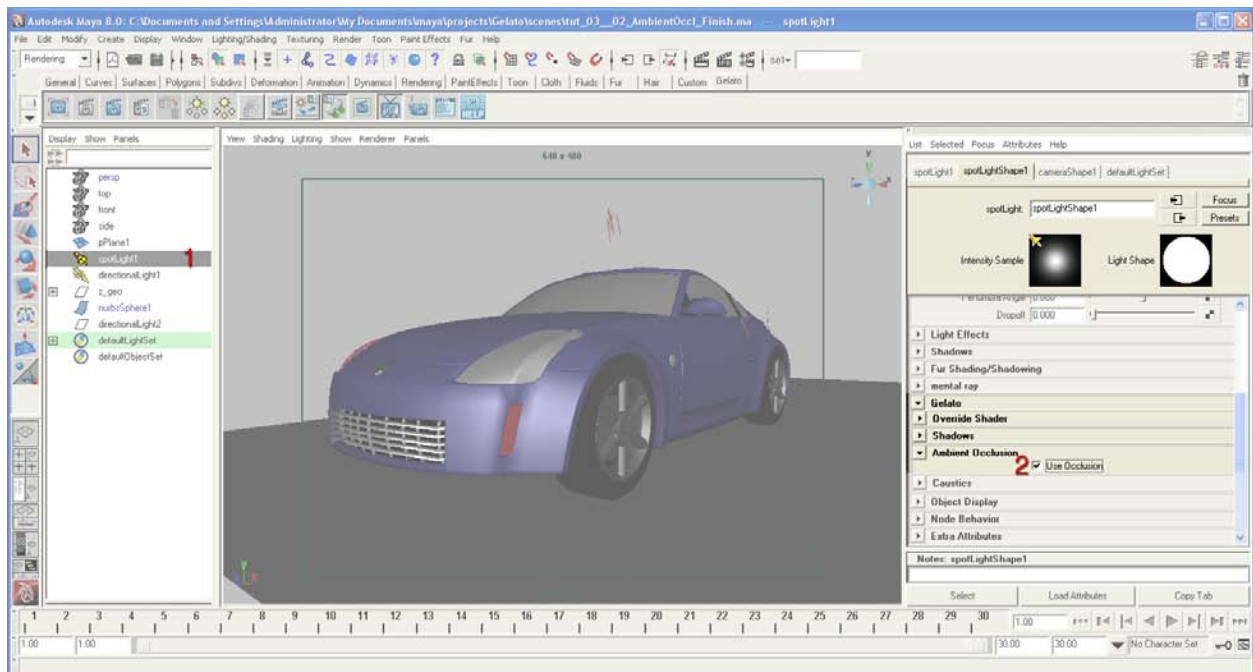


Gelato gives us an alternative to the more traditional ambient occlusion pass we have just seen. Instead of doing a separate ambient occlusion pass, we can do it as part of a composite render. For this, we only want the Beauty pass enabled.

- Render Settings > Output elements > turn off Ambient Occlusion.

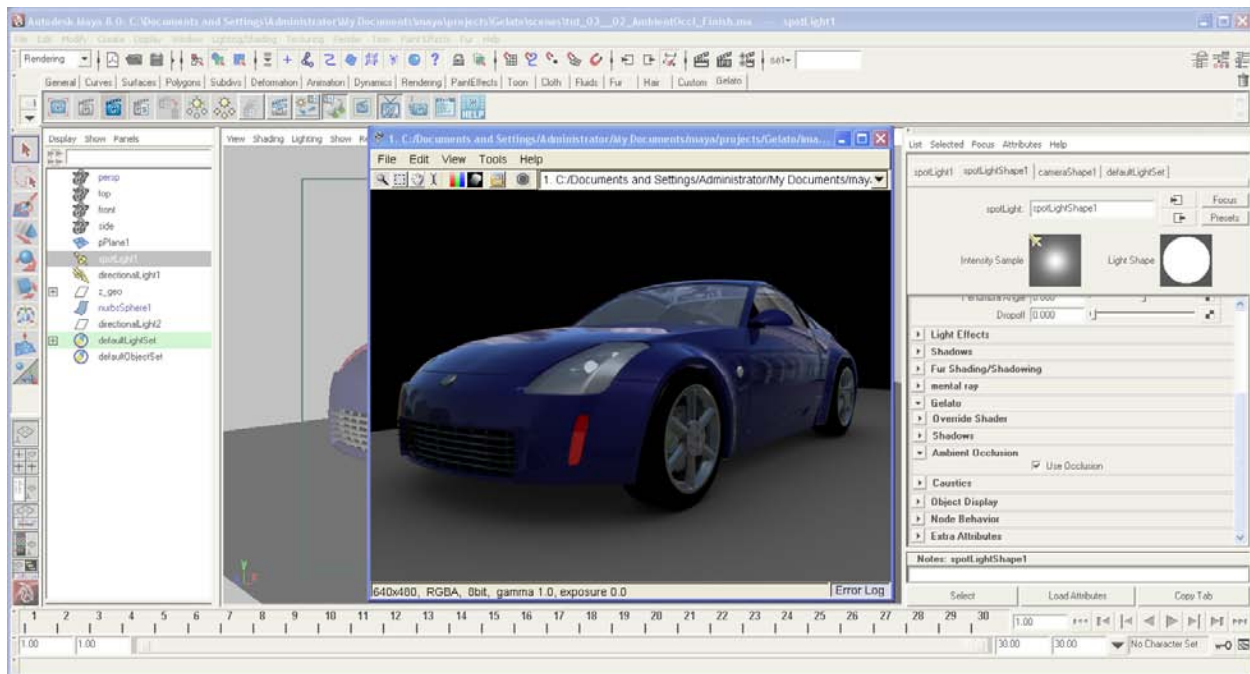


This variation will still reference the settings in the Ambient Occlusion area of the Render Settings.



- Select the spotlight.
- Spotlight's Attribute Editor > Gelato > Ambient Occlusion > enable Use Occlusion.

Since we have already tweaked the Ambient Occlusion parameters in the Render Settings, it's as simple as that.



- Gelato Render.

We now have a beauty pass that incorporates ambient occlusion and you have another option to consider for your workflow.

When you are ready for some more, we will take a look at indirect illumination.