

N I N T E N D O
NITRO-System
NITRO Intermediate File
Plug-In for Maya

Version 1.6.0

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Revision History

Version	Revision Date	Description
1.6.0	4-17-2006	Bug fixes <ul style="list-style-type: none"> Fixed the problem with the incorrect display of normal lines when a non-uniform scale value (X, Y, Z values are not the same) is configured in the node. Fixed the problem of option settings no longer being able to save to scene once a scene with a saved setting of the output plug-in is imported.
	11-28-2005	Bug fixes <ul style="list-style-type: none"> Corrected the imd file's <box test> to output correctly.
	09-12-2005	Functions added/changed <ul style="list-style-type: none"> Added support for Maya 7.0. Added a caution to "2.7.3 Vertex Color" regarding Maya 7.0 .
	06-20-2005	Bug fixes <ul style="list-style-type: none"> Revised the software so that it outputs material color animations and texture SRT animations that use character sets. Fixed problem with color becoming dark in some places when 4x4 texel-compressed textures were created from texture files with names ending in <code>cmp4</code> and without additional information. (The palette data may be larger than in the previous version in some cases.)
	3-24-2005	Bug fixes <ul style="list-style-type: none"> Scene containing reference file was not saved correctly because of influence from output plug-in. This problem was fixed.
	02-28-2005	Functions added/changed <ul style="list-style-type: none"> Added support for Maya 6.5.
	02-02-2005	Functions added/changed <ul style="list-style-type: none"> Added support for the Intermediate File Format Version 1.6.0. Updated the following data creation plug-ins: <ul style="list-style-type: none"> NITRO Set Material Attribute (p. 38, p. 57). Added the Texture Effect Matrix. Deleted the Tex Gen ST.
1.5.0	01-14-2005	Functions added/changed <ul style="list-style-type: none"> Added the batch export feature of intermediate files.
	12-13-2004	Functions added/changed <ul style="list-style-type: none"> Added support for Intermediate File Format Version 1.5.0. Added warning (p. 34). Updated the following data creation plug-in: <ul style="list-style-type: none"> NITRO Set Material Attribute (p. 38) Added attribute that can be set. Added the following data creation plug-ins: <ul style="list-style-type: none"> NITRO Set Render Priority (p. 44) NITRO Show Render Priority (p. 45) Revisions only in the manual <ul style="list-style-type: none"> Added "2.7.9 Polygon Rendering Priority (p. 15). Revised the description of "3.2.2 General Options" Unite and Combine Polygon (p. 26). Revised the description of "3.2.5 Animation Options" Interpolation (p. 30).

Version	Revision Date	Description
1.4.2	10-25-2004	Functions added/changed <ul style="list-style-type: none"> Updated the following data creation plug-ins: <ul style="list-style-type: none"> NITRO Set Material Attribute (p. 38). Added attribute that can be set. Changed the name Lighting to Light0. NITRO Show Lighting (p. 42) Made changes to check four lights separately. Revisions only in the manual <ul style="list-style-type: none"> Revised the description of “2.7.3 Vertex Color.” (p. 14) Revised the description of the intermediate file output plug-in option Interpolation. (p. 25)
	08-30-2004	<ul style="list-style-type: none"> In the imd file, the scale_compensate attribute of <node> is now exported only when the scaling_rule attribute of <model_info> is maya. Corrected the bug that prevented the texture that is connected to the top layer of a layered texture from being exported. In NITRO, when an attempt is made to rename over 16 Characters, a warning is now generated when a texture file cannot be opened. Added support for Maya 6.0.1. Added a note to the manual to note that the differences in the imd file vertex data depends on the Maya version. Added a note to the manual regarding texture pattern animation in Maya 6.0.1. Added an explanation to the manual regarding envelopes in NINTENDO NITRO-System.
1.4.1	07-26-2004	<ul style="list-style-type: none"> Added a warning when a name for export to an intermediate file exceeds 16 characters. (Ch 3.6) Added “element name character string replace (NITRO-Replace Character)” and “rename element names that exceed 16 characters (NITRO Rename Over 16 Characters)” to the data creation plug-in (Table 4.1, Ch 4.9, 4.10) Added warnings about the unit to be used for vertex coordinates and Translate values. (Ch 2.2)
1.4.0	6/30/2004	<ul style="list-style-type: none"> Changed the naming convention for <polygon> element in the imd file to “polygon + serial number”. Several errors and warnings for intermediate file output were added. (pp. 25-26)
1.3.0	5/24/2004	<ul style="list-style-type: none"> Added support for TGA and PIC files that contain additional Nintendo NITRO-System information (paragraph 2.11.2). Added functionality to input and output the option settings for intermediate file output plug-ins as n3es files (paragraph 3.1). Added scaling rule to ica file <node_anm_info>.
1.2.1	4/20/2004	<ul style="list-style-type: none"> Corrected the version of the intermediate file that can be output from version 1.1.0 to version 1.2.0 in 1 Intermediate File Types (p. 7).
1.2.0	4/12/2004	<ul style="list-style-type: none"> Changed to allow output of intermediate files from NITRO Export in the Nintendo NITRO-System menu. Added functionality to transfer data to the 3D Material Editor. Added functionality to store intermediate file output plug-in option settings in a scene. In imd file, changed <material> polygon mode from “toon hilight” to “toon highlight”.
1.1.1	3/25/2004	<ul style="list-style-type: none"> Made corrections to indicate that <polygon> with vertex color does not combine with <polygon> without vertex color when Compress Node is Unite and Combine Polygon or Compress Material is Compress. Made corrections so that the Merge Useless Node process is the same as the manual

Version	Revision Date	Description
		<p>algorithm. (In the previous version, when the root node for the exported imd file was <code>world_root</code>, there were occasions when it changed to another node. Because the total number of nodes and the layer structure did not change, there is no need to re-export the <code>ica</code> and <code>iva</code> files.)</p> <ul style="list-style-type: none"> • Made corrections so that <code>pos_scale</code> in <code><box_test></code> is not larger than necessary.
1.1.0	3/1/2004	<ul style="list-style-type: none"> • Added Use Primitive Strip to the Imd Options output options. • Added support for the A3I5 translucent texture. • Made a correction so that for textures other than translucent textures, if the alpha of the texture file is 128 or larger the texel is considered to be opaque. • Made a correction so that in the color index format, targa files with alphas are processed correctly. • The <code>volume_min</code>, <code>volume_max</code>, and <code>volume_r</code> attribute values included in the <code><node></code> element were being unnecessarily multiplied with (2 to the power of <code>pos_scale</code>). This has been corrected. • In the manual, the limits on the names that the Nintendo NITRO-System uses (node names, material names, texture names, and palette names) have been changed from a maximum of 15 characters to a maximum of 16 characters. • Added the section 2.12.5 Shapes Output by the imd File. • Changed the code in section 5.3 Maya Texture Matrix (<code>m[15]</code> only).
1.0.2	2/12/2004	<ul style="list-style-type: none"> • Made a change to stop the division into triangular polygons and output of quadrilateral polygons and concave quadrilateral polygons for which all vertices are not on the same plane. In Maya, all quadrilateral polygons will now be output as quadrilateral polygons. If this does not display properly on the production device, divide into appropriate polygons in Maya. • Support for changing the number of faces after skinning. Division into triangles is now possible after skinning. However, as before the number of vertices cannot be changed. • Changed so that if the 4 x 4 texel compressed texture palette exceeds 32786 colors, the image quality drops and the palette is compressed to less than 32786 colors.
1.0.1	2/2/2004	<ul style="list-style-type: none"> • Changed the valid digits of the Magnify and Tolerance output options to the 4th decimal place. • Fixed a bug where Maya would crash if, when the Texture SRT Animation is set, another animation file is output without outputting the ita.
1.0.0	1/23/2004	Initial version.

1 Intermediate File Types

The following table shows the different types of intermediate files that can be output from this plug-in.

Table 1-1 Types of Intermediate Files

Extension	Type of data	Description
imd	Model data	Model information, including vertex, polygon, hierarchy, material and texture data
ica	Character animation data	Animation information for controlling node matrices
iva	Visibility animation data	Animation information for controlling node visibility (show / hide)
ima	Material color animation data	Animation information for controlling material color
itp	Texture pattern animation data	Animation information for substituting numerous textures
ita	Texture SRT animation data	Animation information for controlling texture matrices

The version of the intermediate file output from this plug-in is 1.5.0.

2 Precautions Regarding Creation Data for NITRO

2.1 Maya Version ---

This plug-in is for Windows Maya 5.0.1, 6.0.1, 6.5, and 7.0. Operation is not guaranteed for any other version of Maya.

2.2 Preference Settings ---

We recommend that in “Settings” you set “Linear” to `centimeter`.

Vertex coordinates and Translate values are always output to intermediate files and automatically converted to centimeters.

Notice that if you use something other than centimeters, the coordinate values and the Translate values in Maya will differ from those in the Intermediate Files.

In “Settings”, Angular should be set to degree.

2.3 Nodes

2.3.1 Root Node ---

Intermediate files always have a single root node.

If a number of root nodes have been created in Maya, the plug-in groups all of them together into a single node called `world_root` and adds this to the Intermediate file that gets exported.

2.3.2 Nodes that are not Exported ---

- ***Transform* nodes and *joint* nodes are not exported when the Template attribute is set to ON and the Display Layer makes them invisible. (The exception is for influence objects.)**
- **When a node is not exported, none of its child nodes are exported either.**
- ***Transform* nodes that do not possess child nodes (*locator*, empty *group*, etc.) are not exported.**
- **When the *mesh* node's Template attribute or Intermediate Object attribute is set to ON, the parent *transform* node is exported as a node without a *mesh* node (polygon data is not exported).**
- **Nodes are not exported if the Shading attribute of their Display Layer is OFF (always wireframe display).**

Note: Nodes are always exported, regardless of the above conditions, if the node-culling disable flag is set by the [NITRO Set No Cut Node](#) plug-in.

2.3.3 Culling Nodes that are not Needed for Model Display

In addition to the previously mentioned nodes that are not exported, you can specify to cull and not export nodes that are not required for model display. This is done using the Intermediate File Plug-in option “[Compress Node](#)” and selecting “Cull Useless Node” or “Merge Useless Node”.

Also, in situations where node hierarchy is not necessary such as for topographic data, you can select “Unite” or “Unite and Combine Polygon” in this Compress Node option to merge multiple nodes into a single node for export.

2.3.4 Node Names

Note: If you are using the Nintendo NITRO-System library, node names should be no larger than 16 characters in length.

You need to be careful with node names because Maya will accept nodes with the same name as long as they have different parent nodes. If multiple nodes with the same name exist, the node that is shallowest in the hierarchy will be exported with its original name, and all other nodes will be exported with node names appended with a suffix comprising the underscore and a number (_1, _2, etc.). If you are using the Nintendo NITRO-System library, be aware that the node name must be no longer than 16 characters including this suffix.

If multiple nodes with the same name exist at the same depth in the hierarchy, then the node that gets exported with its original name will be the node that is displayed at the top when Sort Order is set to Scene Hierarchy in the Outliner.

2.4 Animation

2.4.1 Time Axis

All of the Intermediate file's animation data are exported in values of integer frames.

Be aware that when a stepped tangent is specified for a key at a frame fraction, the timing may deviate from that in Maya during slow play on NITRO.

2.4.2 Values Exported to the `imd` File

When an attribute is animated, the value that is exported to the `imd` file is the Start frame as specified in the Export Options. For the Translate, Rotate and Scale attributes of nodes that are affected by skinning, the value that is exported is the state of the bind pose.

Be aware that the value that is exported is not the value for the current frame in Maya.

2.5 The transform Node

The following attributes of the *transform* node can be animated: Translate, Rotate, Scale, and Visibility.

Attributes that require special care are explained below:

- Pivot

We recommend that you set Rotate Pivot and Scale Pivot to the same value. If they are different, the volume of animation data could increase.

When data is exported, Rotate Pivot is treated as the origin in local coordinate space.

If Pivot is not the same in every frame, data cannot be output correctly. Do not animate Pivot.

- Shear

Set Shear all to 0. Otherwise, data cannot be output correctly.

- Rotate Order

We recommend the Rotate Order be set to xyz. If it is set to anything else, the volume of animation data could increase.

- Rotate Axis

We recommend setting Rotate Axis all to 0. Otherwise, the volume of animation data could increase.

- Inherits Transform

Set Inherits Transform to ON. If it is set to OFF, data cannot be output correctly.

- Visibility

If the transform node visibility is set to OFF, all levels of nodes below that will not be displayed. If you want to display the polygon models of only specific levels, set the mesh node visibility to off.

2.6 The joint Node

The following attributes of the *joint* node can be animated: Translate, Rotate, Scale, and Visibility.

Attributes that require special care are explained below:

- Rotate Order

We recommend the Rotate Order be set to xyz. If it is set to anything else, the volume of animation data could increase

- Rotate Axis

We recommend setting Rotate Axis all to 0. Otherwise, the volume of animation data could increase.

- Inherits Transform

Set Inherits Transform to ON. If it is set to OFF, data cannot be output correctly.

- Joint Orient

We recommend setting Joint Orient all to 0. Otherwise, the volume of animation data could increase.

- Segment Scale Compensate

Do not change the Segment Scale Compensate value when exporting *imd* files and *ica* files.

2.7 Polygon Models

2.7.1 Polygon Shapes

NITRO cannot display certain polygon shapes correctly. These are listed below. In Maya, first divide these shapes into triangles and then export.

- **Polygons whose vertices do not all lie in the same plane.**
- **Concave polygons with internal angles of 180 degrees or larger.**
- **Polygons with openings.**

As a result of deformations from skinning, polygons with these shapes must also be divided into triangles before output. In Maya, quadrilateral polygons can all be output as quadrilateral polygons. For all polygons with five or more sides, divide into triangles before outputting.

Note: In developing the plug-ins for Maya 5.0.1, Maya 6.0.1, or later, different environments were used. Thus, the order of vertices in the `<polygon>` element and the number of vertices that are processed when linked polygons are used differ in the *imd* files that are created by these versions of Maya.

2.7.2 Setting the Display Face

The display face (front face, back face, or both faces) is set as a shading group attached to the polygons. To set the display face, select either a shading group (*shadingEngine* node) or a material node (Lambert node, etc.) and then execute the [NITRO Set Material Attribute](#) plug-in. Note that the process is not reflected on Maya.

To check the display face, use the [NITRO Show Display Face](#) plug-in.

The *mesh* node's Backface Culling attribute and "Shading" > "Back Face Culling" are only set for display on Maya and are not reflected in the Intermediate file.

2.7.3 Vertex Color

If you have created a model for which vertex color has been specified and you want to display the model without doing a light calculation, use the [NITRO Set Material Attribute](#) plug-in to turn OFF all of the lights that affect the shading group attached to the polygons. (Light 0 is ON by default.)

When the light that is affected is set to ON by the [NITRO Set Material Attribute](#) plug-in, the model can be displayed using a combination of vertex color and light calculations. (However, it remains undecided whether the Nintendo NITRO-System library will support this feature.)

When multiple color sets are set with Maya 7.0, the colors of the current color set are output.

2.7.4 Instances

Even if you use instancing, if there are multiple objects with the same shape, they are all exported in the same way.

2.7.5 Limitations of Combine

If Combine is applied to a skinned object when history is enabled, the skinning animation will display on Maya but it will not be output on NITRO. As a rule, you should delete history after applying Combine.

2.7.6 Vertex Translate Animation Prohibited

Vertex translate animations cannot be exported.

2.7.7 Proxy Shapes

Deform animations (skinning, etc.) that use proxy shapes created with Smooth Proxy cannot be exported. However, the shapes can be exported if they are not animated.

2.7.8 The Number of Valid *mesh* Nodes

Under each *transform* node there should be only one valid *mesh* node that has its Intermediate Object attribute set to OFF. Normally there is only one valid *mesh* node, but a number of them exist when "Deform" > "Display Intermediate Objects" has been executed for a model with skinning configured.

2.7.9 Polygon Rendering Priority

When multiple materials are associated with a single mesh model (equivalent to the `<node>` element in the imd file) in a 3DCG tool, the multiple polygons that constitute the mesh model are divided into multiple polygon groups (equivalent to the `<polygon>` element in the imd file). In such a case, you can control the order in which polygon groups are rendered with respect to each material in the 3DCG tool by setting the **rendering priority** (equivalent to the `priority` attribute of the `<display>` element in the imd file). Rendering priority is used when transparent polygons are displayed overlapping each other or when decal polygons are displayed.

Note: The rendering order mentioned here is the order in which render commands are sent to the NITRO geometry engine. According to the NITRO hardware specification, translucent polygons are always rendered after opaque polygons. Therefore, even if you set priority so that translucent polygons are rendered before opaque polygons, rendering in NITRO will always start from opaque polygons.

If you want to manage rendering order for a polygon group, order it by setting a rendering priority of at least 1 (the lower the value the earlier it is rendered).

If there is no need to specify rendering order for a polygon group, set the rendering priority to Don't care. The rendering routine will determine the rendering timing for polygon groups that have a rendering priority of Don't care. If there are multiple polygon groups with the same rendering priority, the rendering routine will determine which polygon group to render from.

`<rendering priority>`

Don't care: No order specified (rendering timing is indeterminate).

* Intermediate files handle Don't care as a render priority 0.

1 or more: Render in order from the one with the smallest value.

The rendering routine determines whether to control rendering order inside each node, or in the overall model.

In the following example, rendering order changes according to whether control is done inside each node or for the model overall.

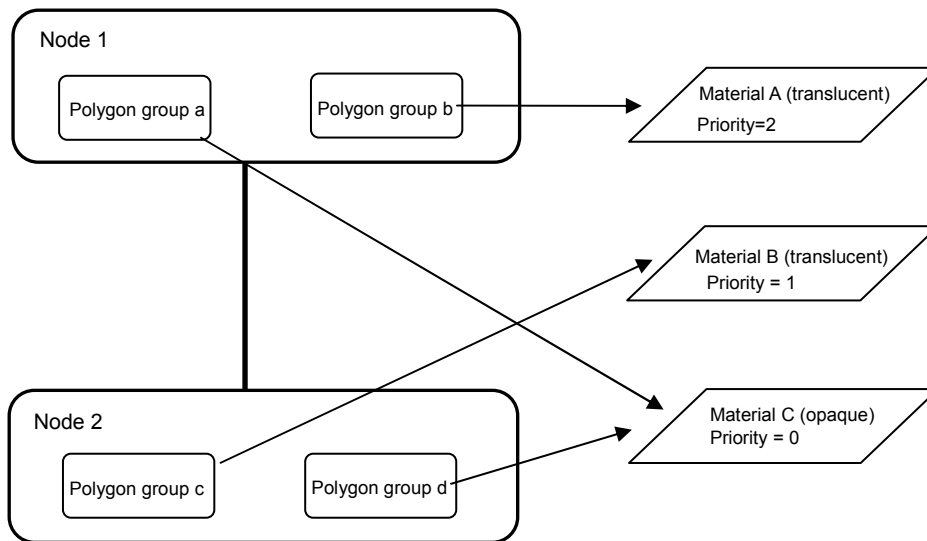


Figure 2-1 Rendering Priority Example

- **Controlling rendering order in each node (equivalent to imd file <node> element):**

Uses a rendering routine that employs generic Push/Pop matrix calculation. When rendering in order from the parent node, it renders the polygon groups on a node basis. Therefore the overall model sends render commands in this order:

"(polygon group a) > b > (a) > (d) > c (d)" (either a or d)

- **Controlling rendering order over the entire model (imd file)**

In the case of a rendering routine that first does the required matrix calculations and then collectively sends render commands, there is no need for the rendering order to depend on the parent/child relationship. Therefore, it is possible to render all of the polygon groups in the model according to the rendering priority. In a node configuration like that shown above, render commands would be sent as shown below.

"(polygon group a,d) → c → (a,d) → b → (a,d)" (either a or d)

Since the rendering priority for polygon groups a and d is Don't care, the rendering routine will determine when to render each.

Note: The rendering routine in the G3D library that is supplied with the NINTENDO NITRO-System controls rendering order using the latter: overall model rendering order.

The [NITRO Set Render Priority](#) plug-in is used to set rendering priority. If you do not set rendering priorities for materials with the [NITRO Set Render Priority](#) plug-in, the materials will be handled as render priority=Don't care. Use the [NITRO Show Render Priority](#) plug-in to check the priorities that have been set.

- **The material compression feature and polygon groups**

If two different materials within the same node have the same content and the same rendering priority, when you use the material compression feature in the intermediate file export plug-in, the materials and the polygon groups will each be combined into one.

If two materials are the same but their rendering priorities are different, the materials will be combined into one, but the polygon groups will not because their rendering priorities are different.

If different nodes contain the same materials and the same rendering priorities, the polygon group will be combined into one, only if Unite and Combine Polygon is specified when culling nodes.

2.8 NURBS Models

NURBS surfaces and NURBS curves cannot be exported. NURBS surfaces should be converted into polygons for export using the NURBS to Polygons operation.

When you convert an animated NURBS model into polygons, the polygon model will also be animated on Maya, but on NITRO it will be fixed in the state of the Start frame. You need to first delete the polygon model's history and then configure animation for it.

2.9 Subdivision Surfaces

Subdivision surfaces cannot be exported. Subdivision surfaces should be converted into polygons for export using the Subdiv to Polygons operation.

2.10 Materials

2.10.1 Material Types and Attributes

Use a Lambert shader if you are not using Specular. Otherwise, use a Blinn, Phong, or Phong E shader. All three of these shaders output data the same way.

These attributes get reflected in the Intermediate file that is exported:

- **Color** → `diffuse`
- **Transparency (R value)** → `alpha`
- **Ambient Color** → `ambient`
- **Incandescence** → `emission`
- **Diffuse** → `Scale multiplied by diffuse`
- **Specular Color** → `specular`

You can configure attributes for NITRO using the [NITRO Set Material Attribute](#) plug-in.

When a *file* node is attached to the Color attribute, the *file* node's Color Gain attribute gets reflected in `diffuse` but the *file* node's Color Offset attribute does not. When a *layeredTexture* node is attached to the Color attribute, it is the Color Gain attribute of the *file* node attached to the top layer that gets reflected in `diffuse`.

Concerning the transparency attribute, of the RGB values, only the R value is reflected in alpha in the intermediate file. The G and B values are ignored.

When a *file* node is attached to the Transparency attribute, the *file* node's Alpha Gain attribute gets reflected in `alpha` but the *file* node's Alpha Offset attribute does not.

NITRO displays the wireframe when the alpha value is 0. However, in NINTENDO NITRO-System, when alpha is 0, no render command is sent for the polygon to which the material is allocated, and thus it is not displayed. You can set wireframe display with the NITRO Set Material Attribute plug-in.

2.10.2 Material Names

If you are using the Nintendo NITRO-System library, material names should be no longer than 16 characters.

One material name is output to intermediate files for each shading group.

If one material name is linked to multiple shading groups, the name used by the first exported node will be exported, name unchanged. However, other materials will be exported with underscore number combinations (such as "_1", "_2") appended after the material name.

When using the Nintendo NITRO-System Library, make sure that material names, including the underscore and number, does not exceed 16 characters.

2.10.3 Material Color Animation

Animation can be set for the following attributes: Color, Transparency (R value), Ambient Color, Incandescence, and Specular Color. Do not set animation for Diffuse.

When a *file* node is attached to the Color attribute, the animation set in the *file* node's Color Gain attribute gets reflected in `diffuse`.

Concerning the transparency attribute, of the RGB values, only the animation that is set in the R value is reflected in the intermediate file. Animation set in the G and B values is ignored.

When a *file* node is attached to the Transparency attribute, the animation set in the *file* node's Alpha Gain attribute gets reflected in `alpha`.

2.11 Textures

2.11.1 Texture Nodes

Only *file* nodes can be used as textures. Procedural textures like *checker* and *ramp* cannot be exported. Use the Convert to File Texture to convert them to *file* node export them. Connect the file node to the material's color attribute. When a Layered Texture is used, only the texture of the *file* node that is attached to the top layer gets exported.

PSD File textures (psdFileTex nodes) that were added in Maya 6.0 cannot be exported.

2.11.2 Texture Files & Format

When you use TGA or PIC files that contain additional Nintendo NITRO-System information (called additional information below), the texture format, palette name, texel data, palette data and the like that are recorded in the additional information are reflected in the intermediate files.

Currently you can make TGA and PIC files that contain additional information with the Nintendo NITRO-System Photoshop plug-ins. For information on using Nintendo NITRO-System Photoshop plug-ins, see the "Nintendo NITRO-System Photoshop Plug-in Manual."

You can also use all texture file types supported by file nodes in files other than TGA (PIC) files that have additional information. However, in that case multiple textures will not be able to share palette data.

When a texture is exported, it is output using the same file name without the extension. Do not use double-byte characters or katakana characters in file names.

The maximum height and width for texture images is 1024 texels. If the height or the width is not of a size used by NITRO (8, 16, 32, 64, 128, 256, 512, 1024), then texel color is added to the right side or the bottom side in order to export the texture image in a size that is used by NITRO.

In the case of TGA and PIC files that have additional information, the texture format will be the one that is specified in the additional information.

In the case of texture files that do not contain additional information, the texture format is determined automatically based on the following rules. For textures other than translucent textures, alpha values (8-bit) of 128 or greater are considered to be opaque.

(1) When file name without extension ends in `_cmp2`

→ 4x4 texel compressed texture (use linear interpolation with maximum 2 palettes for every 4x4 texels)

(2) When file name without extension ends in `_cmp4`

→ 4x4 texel compressed texture (maximum 4 palettes for every 4x4 texels)

(3) When neither of above, translucent texels and 8 or fewer colors are being used

→ A5I3 translucent texture

(4) When none of above, translucent texels and 32 or fewer colors are being used

→ A3I5 translucent texture

(5) When none of the above, the format is determined based on the number of colors being used

- Number of colors is 2 or less → 2-color palette texture
- Number of colors is 4 or less → 4-color palette texture
- Number of colors is 16 or less → 16-color palette texture
- Number of colors is 256 or less → 256-color palette texture
- Number of colors is 257 or more → Direct color texture

With the exception of the direct color texture format, palette data is also exported.

In the case of TGA and PIC files that have additional information, the palette name will be the one that is specified in the additional information. If the palette name that is specified in the additional information is blank, `_p1` will be appended to the end of the file name (the extension remains unchanged).

In the case of texture files that do not have additional information, `_p1` will be appended to the end of the file name (the extension remains unchanged). If you want multiple textures to share palette data, when you make TGA or PIC files that have additional information, specify the same palette name. However, notice that if you give the same palette name to palettes that have different palette data, an error will occur when you output intermediate files..

Note: If you are using the Nintendo NITRO-System library, texture names (excluding the extension) and palette names should be no larger than 16 characters in size.

2.11.3 Texture Attributes

The following *place2dTexture* node attributes get reflected in the Intermediate file: Translate Frame, Rotate Frame, Mirror U, Mirror V, Wrap U, Wrap V, and Repeat UV.

You should set the *place2dTexture* node's Coverage attribute to (1, 1), the Offset attribute to (0, 0) and the Rotate UV to (0).

When the Wrap U attribute or the Mirror U attribute is set to ON, texture images will not display properly if the image width is not equal to 8 or a greater power of 2. Similarly, when the Wrap V attribute or the Mirror V attribute is set to ON, texture images will not display properly if the image height is not equal to 8 or a greater power of 2.

The NITRO texture matrix becomes an identity matrix (without texture SRT) under this specific set of conditions: the Translate Frame attribute is (0,0), the Rotate Frame attribute is (0) and the Repeat UV attribute is (1,1). When the texture matrix is not an identity matrix, it will output as TexCoord even if Tex Gen Mode has been set to NONE by the [NITRO Set Material Attribute](#) plug-in.

2.11.4 UV Limitations

In Maya, textures are not displayed on surfaces without UV, but NITRO does not have this feature. Set the UV for all polygons to which textures are pasted.

The sizes of UV values must fulfill the following conditions:

$-2048 \leq U \text{ Value} \times \text{Texture Width} < 2048$

$-2048 \leq V \text{ Value} \times \text{Texture Height} < 2048$

When there are no default Translate Frame, Rotate Frame, or Repeat UV values, the result UV values applied to their attributes must fulfill the conditions indicated above. Be careful that Repeat UV, etc., do not become too large.

2.11.5 Texture Pattern Animation

For texture pattern animation, set the *file* node's Use Frame Extension attribute to ON and set keys for the Frame Extension attribute. There is no support for driven keys and expressions.

Note: With the Attribute Editor of Maya 6.0.1 or later versions, the Use Frame Extension attribute is displayed as "Use Image Sequence" and the Frame Extension attribute is displayed as "Image Number." When the "Use Image Sequence" (Use Frame Extension) attribute is set to ON, an expression is automatically connected to the "Image Number" (Frame Extension) attribute. Accordingly, press the key after deleting the expression. Set the Frame Offset attribute to 0.

The texture files are prepared with names that have a numeral in front of the extension corresponding to the Frame Extension (*name.1.tga*, *name.2.tga*, *name.3.tga*...). Make the width and height of each texture file the same.

Note: By default, the only textures exported in the *imd* file are textures specified with a *file* node Image Name attribute and textures that correspond to keyed Frame Extension attributes.

For example, consider a texture with the Image Name *name.1.tga*. If this texture has only two set keys, one at the Start frame with Frame Extension = 1 and one at the End frame with Frame Extension = 4, then only two texture files are exported to the *imd* file: *name.1.tga* and *name.4.tga*. The files *name.2.tga* and *name.3.tga* are not exported even if linear tangents are specified for the animation curve. If no texture corresponding to the animation curve's Frame Extension is exported, the texture that most closely corresponds to the Frame Extension is used as the pattern animation data.

Note: You can forcibly export textures to the *imd* file by specifying them using the [NITRO Set Frame Extension List](#) plug-in.

Thus, for example, if you set the Frame Extension range to "1-4" (1 through 4) for forced export, then all four can be exported with linear tangents specified for the animation curve, even though only two keys are set: one at the Start frame with Frame Extension = 1 and one at the End frame with Frame Extension = 4.

If multiple itp files are being used with a single `imd` file, you must use this NITRO Set Frame Extension List plug-in to make the necessary setting so all required textures are exported in the `imd` file.

2.11.6 Texture SRT Animation

For texture SRT animation, the following attributes of the *place2dTexture* node are animated: Repeat UV, Rotate Frame, and Translate Frame.

2.12 Skinning

2.12.1 Skinning Settings

Smooth skinning is supported. Rigid skinning is not supported.

Smooth skinning is set with: "Skin" > "Bind Skin" > "Smooth Bind"

Note: Do not perform these kinds of operations after "Bind Skin":

- Operations that change the number of vertices
- Deleting a *joint* node that affects skinning
- Changing Rotate Order or Segment Scale Compensate of a *joint* node that affects skinning

If you want to perform any of the above operations, first use "Detach Skin".

You can change the location of a vertex even after "Bind Skin". However, the *tweak* node must be upstream from the *skinCluster* node. (The *tweak* node is usually created upstream from the *skinCluster* node, but in the window that opens from Inputs > All Inputs on the popup menu, the *tweak* node may be downstream from the *skinCluster* node in some situations, like when the order of the Deformers has changed.)

If skinning has been specified, the `imd` file's `translate`, `rotate`, and `scale` are exported in the bind pose state.

If you specify skinning for a model that has a parent node, do not change the parent node's Translate, Rotate and Scale values after "Bind Skin". If you want to translate the entire model, do so by translating the highest-order skeleton.

Do not change the name of an original *mesh* node (~Orig) that has been created after "Bind Skin".

The total skinning weight on a single vertex should be 1.0.

2.12.2 Delete Skinning

The "Detach Skin" **History** option usually should be set to Delete History. If you set the option to Keep History you can maintain weight values, but you will only disable the *skinCluster* node, not detach it completely.

Note: If you Detach with the option set to Keep History, do not perform any operations afterward that change the number of vertices or delete a *joint* node that affects skinning.

Certain operations can be performed even after the option is set to Keep History. These include changing the bind pose and adding skeletons.

2.12.3 Influence Objects

Influence objects are exported as *transform* nodes. (Polygons are not output.)

The Add Influence option **Use Geometry** should be set to OFF.

2.12.4 Skinning and Projection Mapping

If you are going to perform projection mapping (Planar Mapping, Cylindrical Mapping, Spherical Mapping, Automatic Mapping) after Bind Skin, you should set the projecting mapping option **Insert Before Deformers** to ON.

2.12.5 Polygon Shapes Output to the imd File

When setting up skinning, the polygons for the bind pose shape are output to the *imd* file.

However, when using the Unite Compress Node or the Unite and Combine options of the Intermediate File Output Plug-in, the shape of the polygon in the start frame is output. If these functions are used, the same shapes as in Maya can be used with the standalone *imd* file. (Since there will be one node, character animation and visibility animation is not possible).

2.12.6 Envelopes in NINTENDO NITRO-System

The deformation process that is called “skinning” in Maya is called “envelope” in the NINTENDO NITRO-System.

In the NINTENDO NITRO-System, there are two types of envelopes: fully-weighted envelopes and weighted envelopes.

- **Fully-weighted envelopes**

A fully-weighted envelope is an envelope in which each vertex is fully weighted toward a single node. If all the vertices in a polygon mesh use fully-weighted envelopes, the model is called a fully-weighted envelope model.

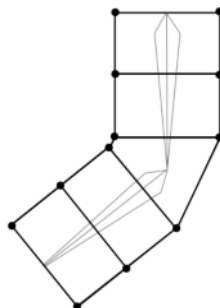


Figure 2-2 An Example of a Fully Weighted Envelope Model

- **Weighted envelope**

A weighted envelope is an envelope in which each vertex is associated with two or more nodes and the total weighting toward these nodes is 100%. If at least one vertex of a polygon mesh is a weighted envelope vertex, then the model is called a weighted envelope model.

A weighted envelope model allows you to create smooth curved surfaces by, for example, increasing the number of nodes that are associated with each vertex or increasing the variety of weighting values. However, this increase will result in a greater amount of calculation during rendering.

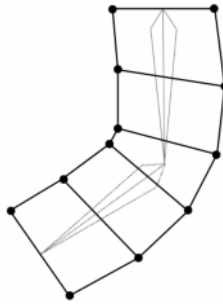


Figure 2-3 An Example of a Weighted Envelope Model

Note: For information on support for weighted envelope models in the G3D library provided by the NINTENDO NITRO-System, see the G3D Library Release Notes.

2.13 Visibility Animation

There are two ways to configure visibility animation: by animating the Visibility attribute of the *transform* node, and by animating the Visibility attribute of the *mesh* node.

- When the *transform* node's Visibility attribute is animated, the Visibility ON/OFF state affects all nodes lower in the hierarchy.
- When the *mesh* node's Visibility attribute is animated, the Visibility ON/OFF state only affects polygons in the same level of the hierarchy. In order to set keys for the *mesh* node's Visibility attribute, select *mesh* node, open “Window” > “General Editors” > “Channel Control” and then set visibility to Keyable.

The visibility animation settings are configured in regard to nodes, so if you have set the Compress Node intermediate file export plug-in option to either “Cull Useless Node” or “Merge Useless Node” be sure that you do not end up deleting nodes for which visibility animation has been set. (You can use the [NITRO Set No Cut Node](#) plug-in to prevent deletion of specified nodes.) When exporting visibility animation, do not set Compress Node to either “Unite” or “Unite and Combine Polygon”.


2.14 Billboard

Billboard is set in regards to the *transform* node using the [NITRO Set Billboard](#) plug-in. However, this is not reflected on the Maya screen. You can check the billboard using the [NITRO Show Billboard](#) plug-in.

3 The Intermediate File Export Plug-In

3.1 How to Use

To only export specified nodes (including nodes at lower hierarchical levels), select the node that you want to output. If you are exporting the entire scene you do not need to select nodes.

Click “Nintendo NITRO-System” > “NITRO Export”  to display the “NITRO Export Option” window.

To output an intermediate file, set the appropriate options and then click either “Export” or “Apply.” Unlike “Export,” “Apply” does not close the option window after output. The option settings at the time of output will be recorded in Maya as the current options. You can also save the option settings in a scene, or input and output them as an n3es (NITRO 3D Export Settings) file. For details see “3.3 Managing Option Settings.”

Click “Nintendo NITRO-System” > “NITRO Export” if you want to output with current options without displaying the option window.

3.2 Options

3.2.1 Output Options

These options relate to methods of outputting intermediate files.

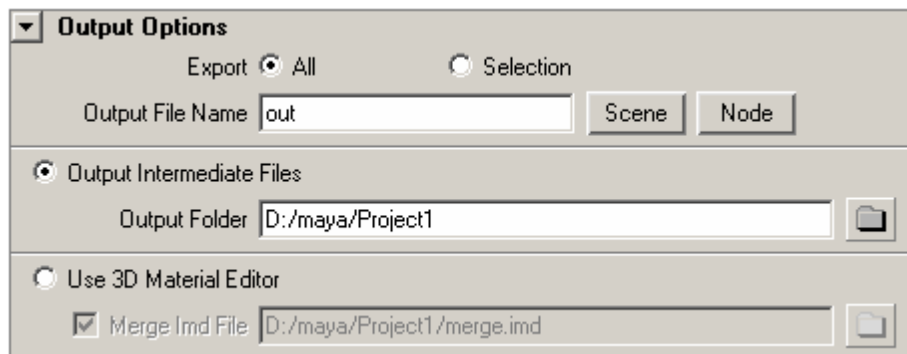


Figure 3-1 Output Options

- Export

To output the entire scene specify “All”. To only output the selected node and those below it, specify “Selection.”

An exception is when you select a model that is set for skinning and specify “Selection.” In that case, nodes that are influenced by the skinning, and nodes at a hierarchical level higher than the model that is set for skinning, will also be output.

- Output File Name

This sets the intermediated file name (but not the extension). Do not use full-width or half-width kana characters.

If you click the “Scene” button that is on the right, the current scene name will be set. If you click the “Node” button, the selected node name (the node at the highest hierarchical level) will be set. If you click the “Node” button without selecting a node, the name of the first node (in alphabetical order) will be set.

- Output Intermediate Files

Select this if you want to output intermediate files to a specified folder.

In “Output Folder” specify the folder to which you want to output intermediate files. Do not use full or half width kana characters.

- Use 3D Material Editor

Select this to transfer intermediate file data to the 3D Material Editor. You cannot select both Output Intermediate Files and Use 3D Material Editor at the same time.

If you turn “Merge Imd File” ON, and specify the imd file path name, after the data has been transferred, the 3D Material Editor will automatically merge-load the specified imd file. Do not use full or half width kana characters in the imd file path name.

For information on using the 3D Material Editor, read the *Nintendo NITRO-System 3D Material Editor* manual.

3.2.2 General Options

The following general options apply to all Intermediate files:

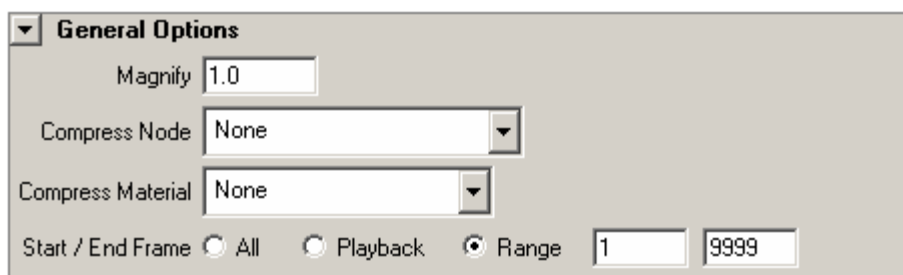


Figure 3-2 General Options

- Magnify

The power to which to multiply the model's vertex coordinates and Translate value.

- Compress Node

This specifies the node-culling mode. By reducing the number of nodes you ease the processing load for matrix calculations and use less memory.

The culling involves the nodes exported to the Intermediate file and does not change the data on Maya.

Table 3-1 Node Culling Modes

Mode	Explanation
None	Nodes are not culled. The hierarchical structure created on Maya is exported as-is.
Cull Useless Node	Data are output after culling nodes that are not needed for model display. Effective for models that use skinning.
Merge Useless Node	In addition to the "Cull Useless Node" process, nodes that can compose a matrix are so composed for export. This extra process usually results in even fewer nodes than with just Cull Useless Node, but the following restriction applies to the Scale value: For nodes with children you must configure a non-uniform Scale (i.e., one where the Scale x, y, z values are not the same). The model may not display properly if you cull nodes that do not comply with this restriction and their children nodes. If the Scale value is animated, all frames must conform to the above restriction.
Unite	Nodes are combined into a single node and all polygons are output in global coordinates. (The node takes the name <code>world_root</code>) Polygons that belonged to separate nodes (the imd file's <code><polygon></code> elements) are output separately even if the material is the same. Do not select this mode when you are using character animation or visibility animation.
Unite and Combine Polygon	In addition to the Unite process, polygons with the same material are combined. However, polygons with vertex color will not be combined with polygons with no vertex color, and polygons with different render priorities will not be combined even if the material is the same. This boosts display speed over "Unite" but you lose the capacity for detailed clipping. Do not select this mode when you are using character animation or visibility animation.

Note: If the node-culling disable flag is set for a node by the [NITRO Set No Cut Node](#) plug-in, then it will not be culled even if you have selected "Cull Useless Node" or "Merge Useless Node."

See 5.2 [Node Culling Algorithms](#) for details about the "Cull Useless Node" and "Merge Useless Node" algorithms.

- **Compress Material**

Sets the material compression. "None" specifies no compression.

"Compress Same Material" specifies that all materials which have the same attributes are compressed for export as a single material. Note that no compression takes place on materials configured for material color animation, texture pattern animation and texture SRT animation.

Note: Materials will not be compressed even if Compress Same Material is specified if Compress has been set to **Don't compress** with the [NITRO Set Material Attribute](#) plug-in.

- **Start / End Frame**

The range of animation (start frame to end frame) to export.

If All is selected, the entire range of animation in Maya (Animation Start / End) will be output.

If Playback is selected, the playback range of animation in Maya (Playback Start / End) will be output.

If Range is selected, the start and end frames can be specified via input of a numeric value. However, if the input value for the start frame is smaller than the Animation Start frame in Maya, the Animation Start frame will become the start frame. If the input value for the end frame is larger than the Animation End in Maya, the Animation End frame will become the end frame.

If an attribute is animated, the value in the start frame will be output to the imd file.

3.2.3 Output File Selection

Check the boxes to specify which types of Intermediate files to export.

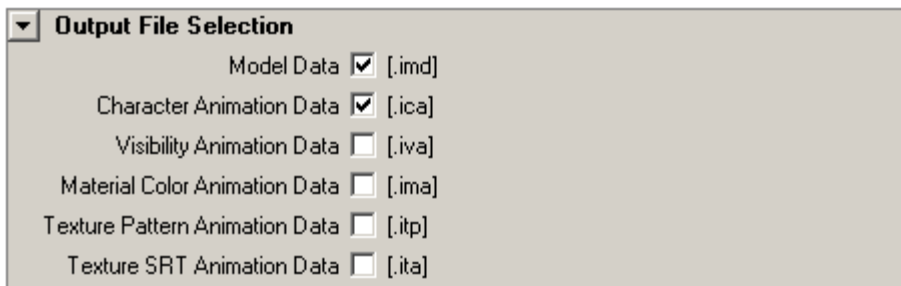


Figure 3-3 Output File Selection

3.2.4 Imd Options

These are the options for imd files:



Figure 3-4 Imd Options

- Vertex Style

Sets the export format for vertex coordinates and vertex color.

Direct specifies direct output of vertex coordinates and vertex color values to the `<polygon>` element.

Index specifies that the matrix of vertex coordinate values is output to the `<vtx_pos_data>` element and the matrix of vertex color values is output to the `<vtx_color_data>` element. The index values for all these matrices are output to the `<polygon>` element.

The Index format is an extended format prepared for a future time when shape animation and vertex color animation can be supported. Normally you should use the Direct format, which is optimized for the NITRO Geometry Engine.

- Output Texture

This specifies the conditions for exporting textures to the imd file.

Only Used specifies output of only those textures that are used in the model.

“All” specifies output of all textures corresponding to the *file* nodes in the scene.

- Force Full Weight

When this is set to ON, the node with the largest weight value is forcedly exported with full weight (100% weight) even if the skinned model's vertex weight value is distributed among numerous nodes. If multiple nodes have the same weight value, then the node that gets exported with full weight is the node with the smallest index when the Compress Node option is “None.” When “Force Full Weight” is set to OFF, the weight value for each node is exported as-is.

- Use Primitive Strip

When set to OFF, polygon strips are not used, and polygons are output either as triangular or quadrilateral polygons.

When set to ON, use triangular and quadrilateral polygon strips if possible, and output as triangular or quadrilateral polygons only the polygons that could not be made into strips.

Compared to the OFF setting, the ON setting allows for a reduction in the number of processing vertices.

3.2.5 Animation Options

The following options apply to animation in general:

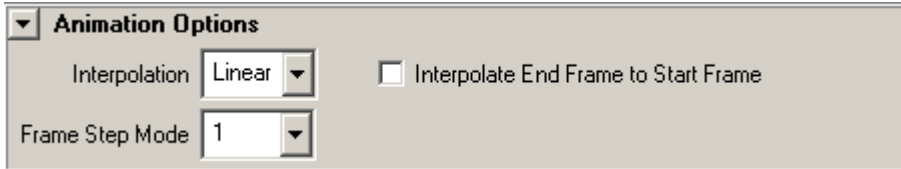


Figure 3-5 Animation Options

- **Interpolation**

Specifies a method of animation playback by obtaining a value in decimal frames.

To round up decimal frames to handle as integer frames for the playback, use **Frame** without discarding the decimal frames. To use linear interpolation for the values in decimal frames, specify **Linear**.

With the G3D library released from the current NITRO-System, it is possible to play in-between frames by setting interpolation to linear. However, compared to frame, linear interpolation will slightly increase the CPU calculation process.

If animation data does not require setting interpolation to linear, with respect to lightening the above-mentioned CPU processing load, be careful to output with interpolation set to frame..

As of February 2005, the G3D library only supports Linear for ica files. Ima files and ita files will play as Frame, even if Linear is specified. For information on the status of support for Linear with ima and ita files see the "G3D Library Release Notes".

- **Interpolate End Frame to Start Frame**

When this is set to ON, interpolation is conducted between the End frame and the Start frame when animation is played with interpolation.

When this is set to OFF, the animation stops in the End frame state after the End frame.

- **Frame Step Mode**

Sets the extent of animation data culling.

- 1** Do not cull; output the data from all frames.
- 2** Output the data from every other frame (this reduces data volume to 1/2 original)
- 4** Output the data from every fourth frame (this reduces data volume to 1/4 original)

Auto Output the data after determining the optimal amount of culling automatically for each animation curve based on the settings of the Tolerance options.

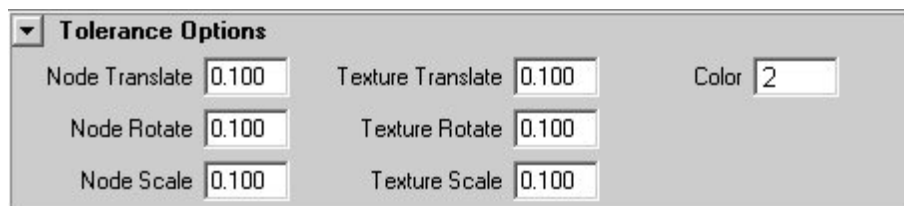
Table 3-2 Frames Output According to Frame Step Mode

Frame Step Mode	Index of frames that get output															
1	0	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15
2	0		2		4		6		8		10		12		14	15
4	0				4				8				12	13	14	15

When the cull number does not divide evenly into (total number of frames - 1), all remainder data is output.

3.2.6 Tolerance Options

These settings define the amount of error to tolerate when optimizing the animation data.

**Figure 3-6 Tolerance Options**

If the largest differences in values between the Start frame and the various frames fall within the specified tolerable levels set here, then the animation values are considered to be uniform and only the Start frame value is exported.

These specified tolerances are also used as the yardstick for the amount of error to tolerate when the Animation option “Frame Step Mode” is set to “Auto” and the decision on how much animation data to cull is determined automatically. The determined amount of culling is such that the maximum errors from linear interpolation falls within the tolerable values set here. The smaller the tolerable error, the higher the precision of the animation, but because there is less culling there is also a greater volume of data.

- Node Translate, Node Rotate, Node Scale

The tolerable error for the Translate, Rotate and Scale values of character animation.

“Node Rotate” is expressed in units of degrees.

“Node Translate” sets the tolerable error for the value after being multiplied by “Magnify.” If the Linear unit is not set to centimeters, this will be the error tolerance of a value that is first converted to centimeters and then Magnified.

- Texture Translate, Texture Rotate, Texture Scale

The tolerable error for the Translate, Rotate and Scale values of texture SRT animation.

“Texture Rotate” is expressed in units of degrees.

- Color
The tolerable error for the diffuse, ambient, specular, emission, and polygon_alpha values of material color animation.

3.3 Managing Option Settings

To save option settings in a scene, or input and output them as an n3es (NITRO 3D Export Settings) file, use the items on the “NITRO Settings” menu on the “Options” window.

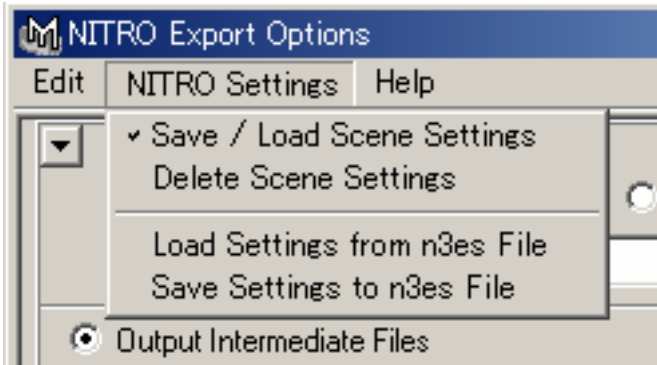


Figure 3-7 NITRO Settings Menu

3.3.1 Saving Option Settings in a Scene

When “Save / Load Scene Settings” is ON (default), when you save a scene, the options that were set the last-time you output intermediate files will be saved in the scene data (Internally, they will be saved in a script node named `nnsExpDialog_Setting1.`). Then, these option settings that you saved with the scene data will be loaded when you open the scene (Set the Open Scene... option “Execute Script Nodes” to ON). If the option settings are not saved in the scene data, the current option settings will remain.

When “Save / Load Scene Settings” is OFF, the options that were set the last-time you output intermediate files will not be saved in the scene data. Also, the option settings will not be loaded when you open the scene data.




If you click “Delete Scene Settings,” the script node that holds the option settings will be deleted.

3.3.2 Inputting and Outputting Option Settings as an n3es File

To output option settings to an n3es file, click Save Settings to n3es File. You can specify an output file name in the file selection window. If the output file’s extension is not `.n3es`, `n3es` will be added automatically.

To input option settings from an n3es file, click “Load Settings from n3es File.” You can specify an input file name in the file selection window. If “Save / Load Scene Settings” on the NITRO Settings menu is on, the script node that saves option settings during a scene will also be updated..

3.4 Output From File > Export All (Selection)

Although you can output intermediate files by going to File > Export All (Selection)  and selecting “Nintendo_NITRO_System” as the File Type, in this case you will not be able to use such features as the one that transfers data to the 3D Material Editor, or the one that saves option settings in a scene. Therefore, in most cases use “Nintendo NITRO-System” > “NITRO Export” . If you do output intermediate files from “File” > “Export All (Selection)” , turn “Default File Extensions” OFF. The extensions of files specified in the file selection window will be ignored. For example, even if you select `abc.txt`, if you are outputting imd and ica type intermediate files, the files will be output as `abc.imd` and `abc.ica`. You may also omit file extensions. Do not specify file names that contain full-width or half-width kana characters.

3.5 Errors During Export

Error messages are displayed in the Output Window when errors occur during export operations. Following is an alphabetical list of errors that warrant special attention.

- 3D Material Editor is Not Found
The 3D Material Editor has not been properly installed. If the `NNS_3DME_ROOT` environment variable is not set properly, fix it and restart Maya.
- Can't open file
This error occurs if the file does not exist, cannot be opened, or cannot be overwritten.
- Influence object is not output
Nodes that are affected by skinning are not exported. This error occurs when the Template attribute of a node affected by skinning is set to ON, or when a node is made invisible by the Display Layer.
- No effective node
This error occurs when there is not even one valid node exported. If you only want to output `locator`, use the [NITRO Set No Cut Node](#) plug-in to set the cut-disable flag.
- No shading group
This means there is no shading group attached to the model. You need to assign a material.
- Texture palette data is not identical
This occurs when more than one texture is using palettes that have the same name, and the palette data in the palettes is different. If palette data content differs, when you make TGA and PIC files that have additional data, specify different palette names.

- Vertex number is different from original mesh
There are times when, as a result of performing operations that change the number of vertices, the number of vertices for the model for which skinning was configured may differ from the number of vertices in the original mesh node (Orig). After performing a "Detach Skin" once, delete the history and then perform Bind Skin again.
- Wrong weighted vertices exist
There are vertices that have a total weight that is not 1.0. Adjust the weight value. If the Normalize Weights attribute of the skinCluster node is on, the total weight will automatically adjust to 1.0 when weights change.

3.6 Warnings During Export

Warnings are displayed in the Output window when they occur during export operations. Following is an alphabetical list of warnings that require special attention.

- Can't Get UV
No UV coordinates have been set for a texture-mapped face. UV coordinates for each of the face's vertices will be exported as U=0, V=0.
- Frame offset is not zero
There is a frame with a file node Frame Offset attribute that is non-zero. This behavior is observed with Maya 6.0.1 and later versions. Note that the texture pattern animation will not be exported correctly.
- Length of Name Over 16 characters
A name to be exported to an intermediate file (node name, material name, texture image name, texture palette name) exceeds 16 characters. Problems may occur when these files use the Nintendo NITRO-System Library.
- Material Name Changed
A material name that will be exported to an intermediate file has been changed because there are duplicate material names. This will occur when for example one material is linked to multiple shading groups.
- **Mtx_prim_size of <polygon> is over 1**
The value of imd file <polygon> mtx_prim_size exceeds 1. This is generated by an envelope model in which more than 31 matrices are required to render a polygon group.

As of February 2005, it is not possible to display this type of imd file with the G3D library that comes with the **NINTENDO NITRO-System (binary conversion is not possible)**. For information on the latest G3D libraries, see "G3D Library Resource List".
- No shader
This means there is no material attached to the shading group. When this occurs, the plug-in automatically adds the default material to the Intermediate file for export.

- Node named changed
Because several nodes with the same name exist, the node name output to the Intermediate file has changed.
- Procedural texture is ignored
Procedural textures like `checker` and `ramp` are not exported as-is (they are ignored). You need to use “Convert to File Texture” to convert these procedural textures into files and export them.
- PSD file texture is ignored
PSD file textures (`psdFileTex` nodes) are not exported. The PSD file textures will be ignored. This behavior is observed with Maya 6.0.1 and later versions.
- Same-named texture file exists
There are two or more texture files with the same name but in different folders or with differing file extensions. If two texture files have the same name, they will be treated as different files if they are in different folders or have differing file extensions. Note that this will output more than one `<tex_image>` with the same name.
- Shear is not zero
The transform node's Shear attribute has a non-zero value so it cannot be exported correctly. If this warning displays, execute “Freeze Transformations” or set all Shear attribute values to 0.
- Size of texture is wrong
The width or height of the texture is not usable by NITRO. (It should be 8, 16, 32, 64, 128, 256, 512, or 1024.) The plug-in will automatically add the texel color to the right or bottom edge of the image so that it becomes an acceptable size for NITRO.
- Texture pattern animation invalid frame extension
This occurs when the texture that corresponds to the Frame Extension value in a specific frame is not output.

Of the textures that are going to be output, the one closest to the Frame Extension value is output to the itp file.

To avoid this warning, correct the animation curve or specify the texture to be forcibly output by the NITRO Set Frame Extension List plugin.
- Texture height must be power of 2 for repeat/flip
If the `place2dTexture` node's “Wrap V” attribute or “Mirror V” attribute is set to ON, the texture will not display properly if the image height is not equal to 8 or a greater power of 2 (8, 16, 32, 64, 128, 256, 512, 1024). If this message occurs, change the texture's height or set the “Wrap V” and “Mirror V” attributes to OFF.
- The number of matrices for displaying this model is over 31
The number of matrices required to display the model exceeds 31.

- Texture width must be power of 2 for repeat/flip
If the *place2dTexture* node's "Wrap U" attribute or "Mirror U" attribute is set to ON, the texture will not display properly if the image width is not equal to 8 or a greater power of 2 (8, 16, 32, 64, 128, 256, 512, 1024). If this message occurs, change the texture's width or set the "Wrap U" and "Mirror U" attributes to OFF.
- The Number of Matrix for Displaying This Model Over 31
More than 31 matrices are required to render this model. The number that follows the warning message is the current number of matrices.
- Total polygon size over
The total number of polygons has exceeded the size of NITRO's polygon list RAM. This means you will not be able to display all of the polygons at the same time. The maximum number of polygons is 2048 triangles or 1706 quadrangles.

If triangles and quadrangles are mixed, the following condition must be met:

$$\text{The number of triangles} \times 20 + \text{the number of quadrangles} \times 24 \leq 40960$$
- Total vertex size over
The total number of Vertex commands has exceeded the size of NITRO's vertex RAM (6144 vertices). This means you will not be able to display all of the polygons at the same time.
- UV range over
This means that the texture coordinate (UV value) exceeds the limitations of NITRO. Change the UV value so that it matches the conditions explained in "2.11.4 UV Limitations."
- Zero normal exist
There is a normal vector whose length is 0. This means that lighting will not perform correctly.

3.7 Batch Export of Intermediate Files ---

3.7.1 Batch Export ---

Besides the usual method of outputting intermediate files by opening a scene in Maya, intermediate files can be output to one or more scenes at once by starting up Maya in a mode that does not display a user interface.

This is called "batch export."

3.7.2 How to Run a Batch Export ---

- (1) Prepare the `n3be` file.

The `n3be` file is a file that specifies which intermediate file to output to which scene under what conditions. Prepare a file according to the separate document `NITRO_n3beFileFormat.pdf`.

- (2) Run a batch export using `NNS_Batch_Export_Maya**.bat` and `n3be` files in `NNS_Maya**_Plugin` folder. (** indicates 50, 60, 65, or 7.0.)

Note: `NNS_Batch_Export_Maya**.bat` needs to be corrected according to `Setup_MayaPlugin.pdf`.

Run the batch export by entering the following at the command prompt:

```
NNS_Batch_Export_Maya**.bat sample.n3be [Enter]
```

You can also run it by dragging and dropping a `n3be` file to `NNS_Batch_Export_Maya**.bat`.

If the batch export completes properly, the following message will appear at the end:

```
Batch Export is finished. Total [number of scenes] scenes.
```

If there is a problem with the description of the `n3be` file, an error message appears and the process is aborted (terminated) at that point.

Major error messages are shown below.

```
Error: "****" is not specified.  
Error: "****" is wrong.
```

If an error occurs with the output of the intermediate file while the batch export is running, the following error message appears:

```
Error: Failed to export
```

The process is aborted (terminated) at that point.

The description of errors and warnings regarding the output of intermediate files is output to the log file specified with `n3be` file.

3.7.3 Supplemental Remarks on Batch Export

To run a batch export, a `n3es` file is required.

To specify which options to use to output intermediate files, specify a `n3es` file in the `n3be` file. Even if the output option setting is saved in the scene file, the batch export will not reference it and always uses the setting in the `n3es` file.

4 Data Creation Plug-Ins

The Data Creation plug-ins assist in the creation of data for NITRO.

These plug-ins are primarily used on Maya nodes to configure and check the attributes for use with NITRO. All components of this Data Creation plug-in can be executed from the Nintendo NITRO-System menu.

The following table lists data creation plug-ins.

Table 4-1 Data Creation Plug-ins

Plug-in Name	Description
NITRO Set Material Attribute	Sets NITRO attributes in a material
NITRO Show Lighting	Checks lighting settings
NITRO Show Display Face	Checks polygon display face settings
NITRO Set Render Priority	Sets polygon rendering priority
NITRO Show Render Priority	Checks polygon rendering priority settings
NITRO Set Billboard	Sets the billboard
NITRO Show Billboard	Checks billboard settings
NITRO Set No Cut Node	Sets the flag that disables node cutting
NITRO Show No Cut Node	Checks the setting of the flag that disables node cutting
NITRO Set Frame Extension List	Sets the texture to be output by texture pattern animation
NITRO Replace Character	Searches and replaces element name character strings
NITRO Rename Over 16 Characters	Searches for and renames element names that exceed 16 characters

4.1 Setting Material Attributes (NITRO Set Material Attribute)

NITRO's polygon attributes and the attributes for such things as the texture coordinates transform mode are exported to the Intermediate file in the form of material attributes. These material attributes for NITRO are configured for individual shading groups using the NITRO Set Material Attribute plug-in. Note that these settings are not reflected in the Maya screen.

Select a shading group (*shadingEngine* node) or a material node (*Lambert* node, etc.) and then execute "Nintendo NITRO-System" > "NITRO Set Material Attribute." (You can select multiple nodes.)

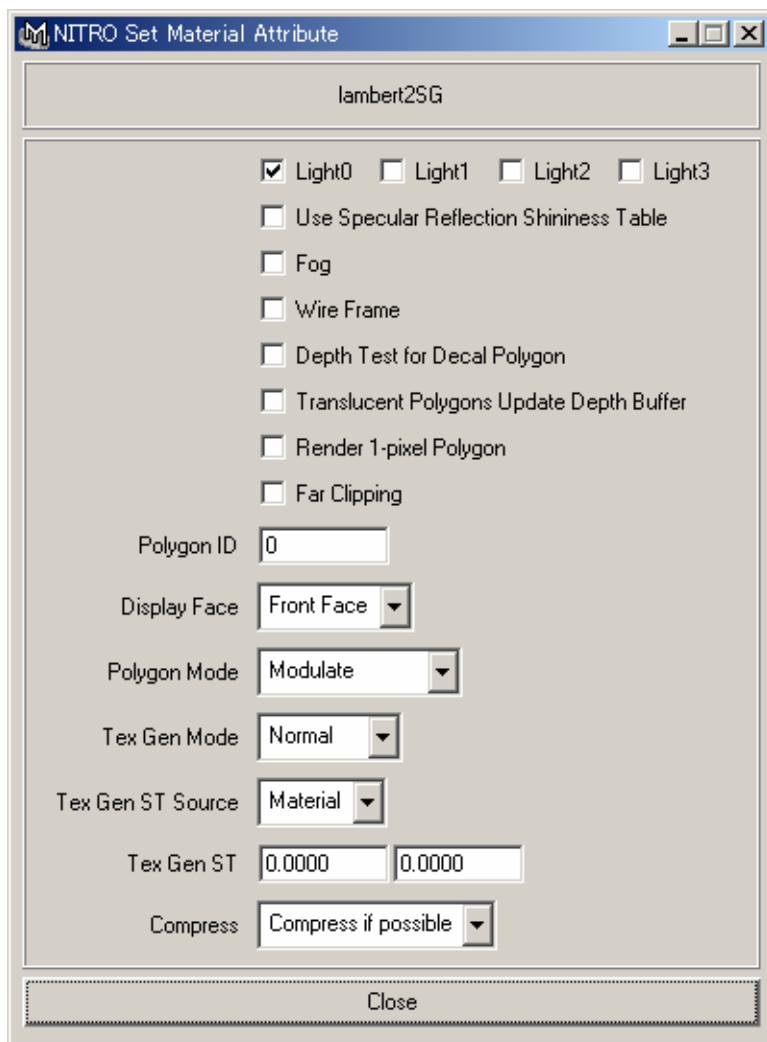


Figure 4-1 The NITRO Set Material Attribute Window

The window displays the selected node's current settings. If you select multiple nodes, the window displays the settings of the first node that was selected.

Operate the various items in the window to change different attributes. If you select multiple nodes, you can change them all at once (reflected only in the changed items).

You can close this window and select a different node to configure the attributes of that node.

- **Light0, Light1, Light2, Light3**

Specifies the light that is affected when it is displayed on NITRO. It is not reflected on the Maya display. By default, Light0 is set to ON, and Light1, Light2, and Light3 are set to OFF.

When any of these lights are on, the normal data of the polygon that belongs to the shading group is output. When all of the lights are off, the normal data is not output.

- **Use Specular Reflection Shininess Table**

Specifies whether to use the Specular Reflection Shininess Table when calculating specular components. By default, it is set to OFF.

When Light0, Light1, Light2, and Light3 are all set to OFF, this attribute cannot be changed, and in the intermediate file it is output as OFF.

- **Fog**

Specifies whether to apply fog. The default is OFF.

- **Wire Frame**

This check box toggles wireframe display on/off. The default is OFF.

- **Depth Test for Decal Polygons**

This specifies whether to do a depth test for decal polygons. When it is on, there will be a depth test for decal polygons. When the depth value of a fragment is the same as the depth in the depth buffer, it will be rendered. When it is off, there will be a normal polygon depth test: when the depth of a fragment is less than the depth in the depth buffer it will be rendered. The default is off.

Render decal polygons after the polygons on which they will be mapped. You can control polygon group rendering order with the [NITRO Set Render Priority](#) plug-in.

- **Translucent Polygons Update Depth Buffer**

This specifies whether to update the depth buffer when rendering translucent polygons. The default is off.

- **Render 1-pixel Polygon**

This specifies whether to render one-pixel (dot) polygons. The default is off.

- **Far Clipping**

This specifies whether to do FAR clipping. When it is on, polygons that intersect the far plane will be clipped. When it is off, polygons that intersect the far plane will be deleted. The default is off.

- **Polygon ID**

Sets the polygon ID. Specify a value between 0 and 63. The default is 0.

- **Display Face**

This specifies the polygon's display face.

Front Face = Display the front face only

Back Face = Display the back face only

Both Faces = Display both faces

The default is Front Face.

- **Polygon Mode**

Sets the polygon mode.

Modulate = Modulation mode

Decal = Decal mode

Toon/Highlight = Toon/highlight shading

Shadow = Shadow polygons

The default is Modulate.

- **Tex Gen Mode**

Sets the texture coordinates transform mode.

None = Do not transform the texture coordinates

TexCoord = TexCoord source

Normal = Normal source

Vertex = Vertex source

The default is None.

When performing environmental mapping, use Normal. When performing projection mapping, use Vertex.

If the attribute is set to None, the data nevertheless will be exported as TexCoord if the material is attached to a texture whose texture matrix is not an identity matrix. (If the mode is set to Normal or Vertex, the texture matrix will not affect what is exported.)

- **Tex Gen ST Source**

When the texture coordinate conversion mode is Normal or Vertex, specify whether or not the texture coordinates of the corresponding polygons will be output.

Polygon outputs the texture coordinates of the polygons. Special mapping expressions are possible, such as transformation of standard attached textures via normal vectors or vertex coordinates.

Material does not output the texture coordinates of the polygon. The Maya attachment method is ignored, and the texture coordinates are determined from the normal vector or the vertex coordinates. When performing general environmental or projection mapping, use Material. This is set to Material by default.

- **Texture Effect Matrix**

When the texture coordinate conversion mode is Normal or Vertex, specify a 4x2 matrix that influences the texture coordinate conversion. When performing environmental / projection mapping, etc., This matrix can be used in adjusting the position, direction, and size of the texture. By inputting a numeric value and pressing the Enter key, it will be converted to a value that NITRO can use (a multiple of 1/4096). The following table describes each component of the matrix.

Table 4-1 Texture Effect Matrix Components

The influence of the X coordinate on the S coordinate	The influence of the X coordinate on the T coordinate
The influence of the Y coordinate on the S coordinate	The influence of the Y coordinate on the T coordinate
The influence of the Z coordinate on the S coordinate	The influence of the Z coordinate on the T coordinate
The amount of the S coordinate offset	The amount of the T coordinate offset

Note: A 4x4 matrix outputs the Intermediate File, but since the third and fourth lines have no

influence on the texture coordinate conversion, with the plug-in this in effect becomes a 4x2 matrix where only the first and second lines can be configured.

Note: When the Tex Gen ST Source is Polygon, the component on the fourth line has no effect.

Cautions for the G3D Library Provided by NINTENDO NITRO-System

With the G3D library, the XYZ coordinates that multiply to the Texture Effect Matrix are as follows:

Environmental Mapping (Tex Gen Mode = Normal)

The coordinates where a normal vector was converted to a view-coordinate type.

Projection Mapping (Tex Gen Mode = Vertex)

The coordinates where the vertex coordinates were converted to a world-coordinate type.

After applying these coordinates to the Texture Effect Matrix, the coordinates that were applied to the "Matrix for Aligning the Center and Position of the Mapping" and the "Texture Scale and Rotate Matrix Designated by the Material" become the final texture coordinates.

For environmental mapping, the fourth line of the Texture Effect Matrix has no effect.

Environmental and projection mapping cannot display properly for the envelope model.

- **Compress**

This sets the flag indicating whether to compress when the [Compress Material](#) option is set to "Compress."

Compress if possible = Compress if the attributes are the same as those of other materials. This is the default setting. Note that even when this setting is selected the material will not be compressed if material color animation, texture pattern animation or texture SRT animation has been configured.

Don't compress = Export as an independent material without compression, even if its attributes are the same as those of other materials.

4.2 Checking the Lighting (NITRO Show Lighting)

Execute by clicking on Nintendo NITRO-System > NITRO Show Lighting.

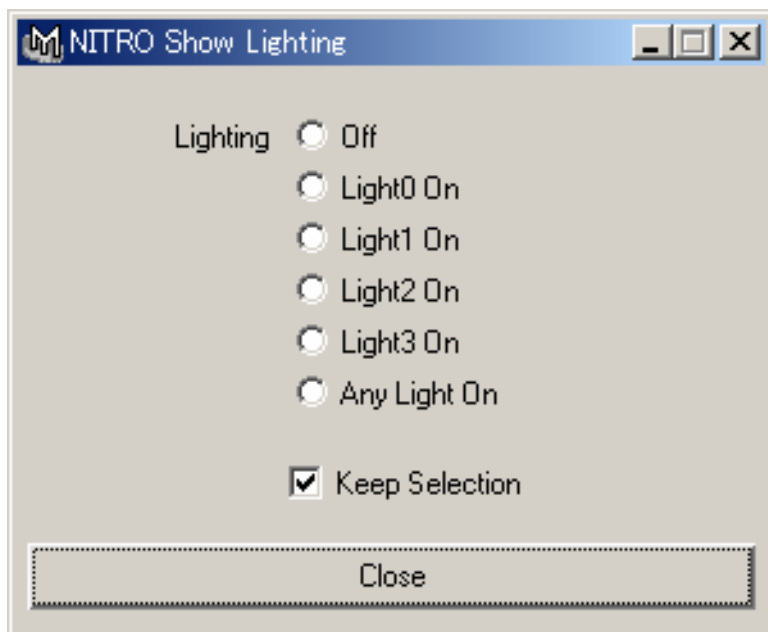


Figure 4-2 The NITRO Show Lighting window

When executed, a Window will appear. Click a radio button to display the shading groups set for that mode and the polygons that belong to the shading groups in the selected state.

Off	not affected by any light
Light0 On	affected by Light0
Light1 On	affected by Light1
Light2 On	affected by Light2
Light3 On	affected by Light3
Any Light On	affected by any light

You can get a better idea of the results by selecting "Rendering" > "Show ShadingGroups in Hypergraph."

When "Keep Selection" is set to ON, the pertinent shading groups and the polygons that belong to the shading groups can be maintained in their selected state after the window is closed. When it is set to OFF, the selection state reverts to what it was prior to the execution of "NITRO Show Lighting."

4.3 Checking the Polygon Display Surface (NITRO Show Display Face)

Execute by clicking on “Nintendo NITRO-System” > “NITRO Show Display Face.”

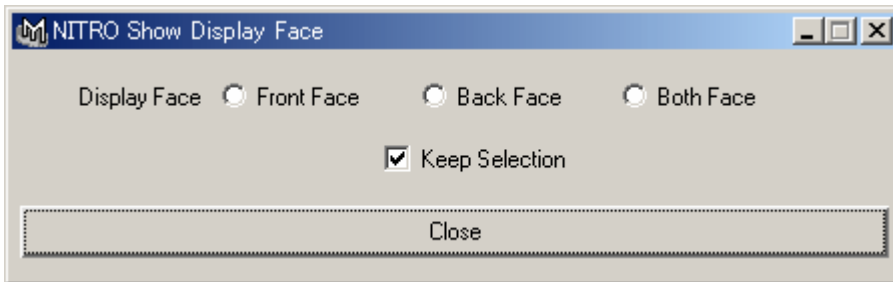


Figure 4-3 The NITRO Show Display Face window

Click on a polygon “Display Face” mode in the window that opens up to display the shading groups set for that mode and the polygons that belong to the shading groups in the selected state.

You can get a better idea of the results by selecting “Rendering” > “Show ShadingGroups in Hypergraph.”

When “Keep Selection” is set to ON, the pertinent shading groups and the polygons that belong to the shading groups can be maintained in their selected state after the window is closed. When it is set to OFF, the selection state reverts to what it was prior to the execution of “NITRO Show Display Face.”

4.4 Polygon Rendering Priority Setting (NITRO Set Render Priority)

The NITRO Set Render Priority plug-in sets polygon rendering priority for shading groups. For information on polygon rendering priority see 2.7.9 Polygon Rendering Priority.

Run NINTENDO NITRO-System > NITRO Set Render Priority after selecting a shading group (shadingEngine node) or a material node (Lambert node, etc.). Multiple selections are possible.

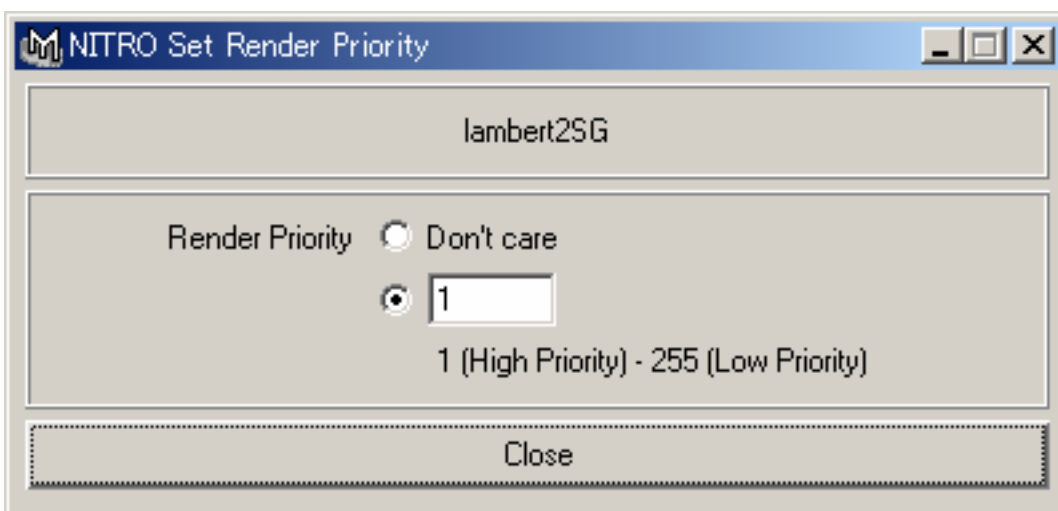


Figure 4-4 The NITRO Set Rendering Priority Window

The window displays the current settings for the selected node. In the case of multiple selections it shows the settings for the node that was selected first.

Use the radio button to the right of Render Priority to select either Don't care (no rendering priority specification) or select a numerical specification. If you specify a number, enter an integer from 1 to 255 and press the Enter key. Polygons that belong to shading groups with lower numbers will be rendered first. If multiple shading groups have the same number, which shading group's polygons will be rendered first is indeterminate (it depends on the rendering routine).

If you select another node without closing the window you will be able to set that node.

4.5 Checking Polygon Rendering Priority (NITRO Show Render Priority)

Click NINTENDO NITRO-System > NITRO Show Render Priority to run it.

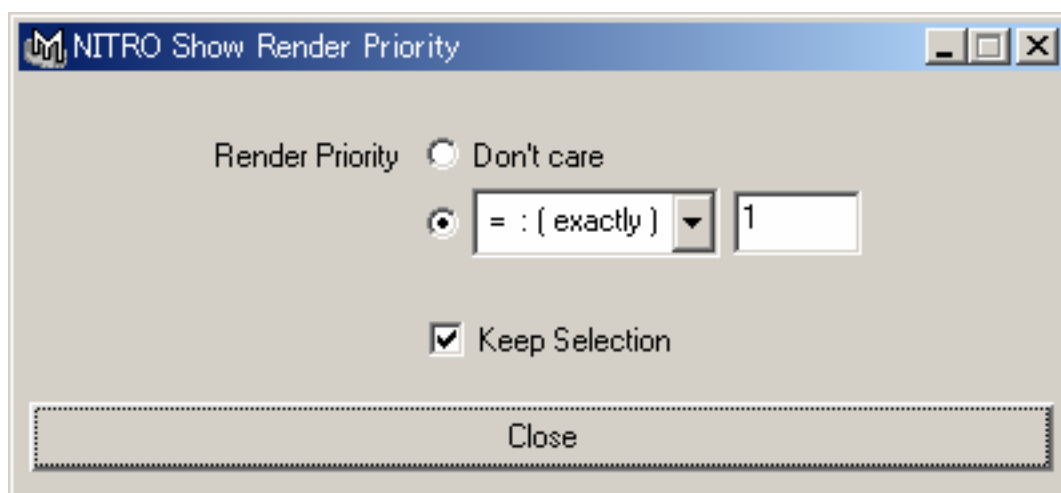


Figure 4-5 The NITRO Show Render Priority Window

When you run the plug-in this window will open. If you use the radio button to the right of Render Priority to select Don't care (do not specify rendering order) or to select condition specification and specify a condition, the relevant shading groups and polygons that belong to them will be displayed as selected. You can set the following conditions: less than (<: under), less than or equal to (<=: below), equal to (=: exactly), greater than or equal to (>=: above), greater than (>: over). You can use integers 1 through 255.

It will be easier to see the results if in Hypergraph you set Rendering > Show ShadingGroups.

If you select Keep Selection, the shading groups and the polygons that belong to the shading groups will remain in selected state even after the window is closed. If this item is off, they will return to the selection status before you ran NITRO Show Render Priority.

4.6 Setting the Billboard (NITRO Set Billboard)

Billboard is set for *transform* nodes and *joint* nodes using the NITRO Set Billboard plug-in. Note that the settings are not reflected on the Maya screen.

Select a *transform* node or a *joint* node (you can select multiple nodes) and then click on “Nintendo NITRO-System” > “NITRO Set Billboard” to execute.

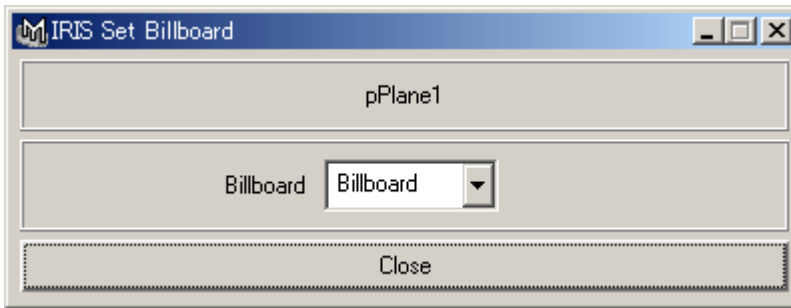


Figure 4-6 The NITRO Set Billboard Window

The window shows the current settings of the selected node. If you have selected multiple nodes, the window shows the settings of the last selected node.

Click on the combo box to change the billboard mode. If multiple nodes are selected, all selected nodes can be changed at the same time.

No Billboard = No billboard

Billboard = Always display in the direction of the camera

Y-Billboard = Display in the direction of the camera, centered along the global Y axis

If you select another node without closing the window you can set that other node.

4.7 Checking the Billboard (NITRO Show Billboard)

Execute by clicking on Nintendo NITRO-System > NITRO Show Billboard.

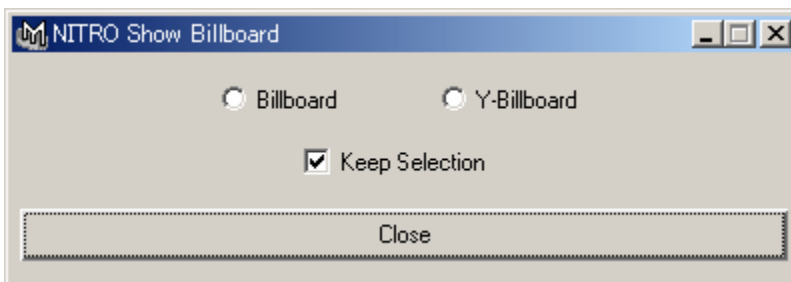


Figure 4-7 The NITRO Show Billboard Window

Click on a billboard mode in the window that opens up to display the *transform* nodes and *joint* nodes that have been set to that mode in the selected state.

When “Keep Selection” is set to ON, the pertinent nodes can be maintained in their selected state after the window is closed. When it is set to OFF, the selection state reverts to what it was prior to the execution of “NITRO Show Billboard.”

4.8 Setting the Node-Culling Disable Flag (NITRO Set No Cut Node)

The NITRO Set No Cut Node plug-in sets the flag for *transform* nodes and *joint* nodes such that even when the node-culling feature is enabled the nodes are not culled when the Intermediate file is output.

Select a *transform* node or a *joint* node (you can select multiple nodes) and then click on “Nintendo NITRO-System” > “NITRO Set No Cut Node” to execute.

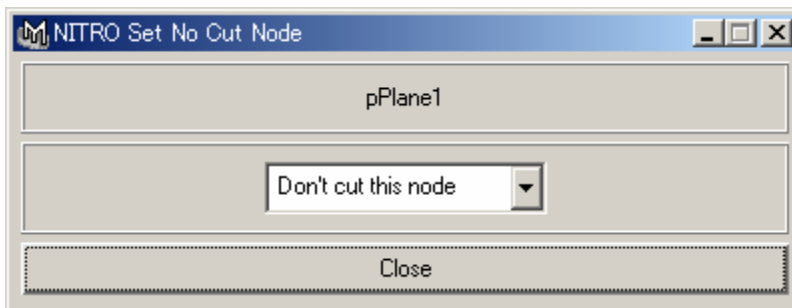


Figure 4-8 The NITRO Set No Cut Node Window

The window shows the current settings of the selected node. If you have selected multiple nodes, the window shows the settings of the last selected node.

Click on the combo box to change the flag that disables node culling. If multiple nodes are selected, all selected nodes can be changed at the same time.

“Cut this node if possible” = When the node-culling feature is enabled, cull nodes that can be culled. This is the default setting.

“Don’t cut this node” = Do not cull nodes even if the node-culling feature is enabled.

If you select another node without closing the window you can set that other node.

4.9 Checking the Node-Culling Disable Flag (NITRO Show No Cut Node)

Execute by clicking on “Nintendo NITRO-System” > “NITRO Show No Cut Node.”

When this executes, those *transform* nodes and *joint* nodes that have the flag that disables node culling set to “Don’t cut this node” are shown in the selected state.

4.10 Setting the Textures Exported with Texture Pattern Animation (NITRO Set Frame Extension List)

By default, the only textures that are exported to the Intermediate file for texture pattern animation are those textures specified with a *file* node Image Name attribute and textures that correspond to keyed Frame Extension attributes. However, you can use the NITRO Set Frame Extension List plug-in to forcibly export textures corresponding to specific frame extensions.

Select only one *file* node (or *material* node) and then click "Nintendo NITRO-System" > "NITRO Set Frame Extension List" to execute.

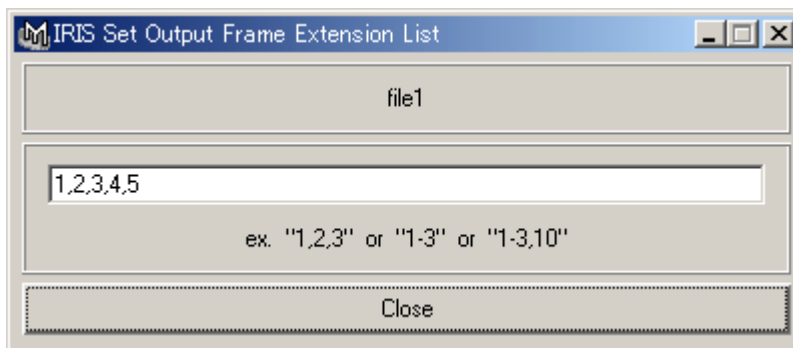


Figure 4-9 The NITRO Set Frame Extension List Window

In the resulting window, enter a list of texture numbers (frame extensions) to export to the Intermediate file.

The format is: 1,2,3... Separate each number with a comma. If the *file* node's Image Name is `name.1.tga` then the three textures `name.1.tga`, `name.2.tga`, and `name.3.tga` will be exported even if they do not correspond to keyed Frame Extension attributes.

If no corresponding texture exists for a specified number, an error will be generated when data are exported. A negative number cannot be specified for a texture number.

A series of numbers (e.g., "1,2,3,4,5") can be written as a range separated using a hyphen (e.g., 1-5)

Entering "3-6,10" is the same as entering "3,4,5,6,10."

You can use a space in place of a comma to separate numbers.

Entries made in the following formats will generate errors:

- | | |
|-------|--|
| 1-3-5 | Error because two or more values are separated using hyphens |
| -3 | Error because value begins with a hyphen |
| 5- | Error because value ends with a hyphen |

4.11 Replace Element Name Character Strings (NITRO Replace Character)

This plug-in collectively replaces element name character strings (object name, material name). You can also change element name characters from uppercase to lowercase, or from lowercase to uppercase.

To use this plug-in, select **Start > NINTENDO NITRO-System > NITRO Replace Character**.

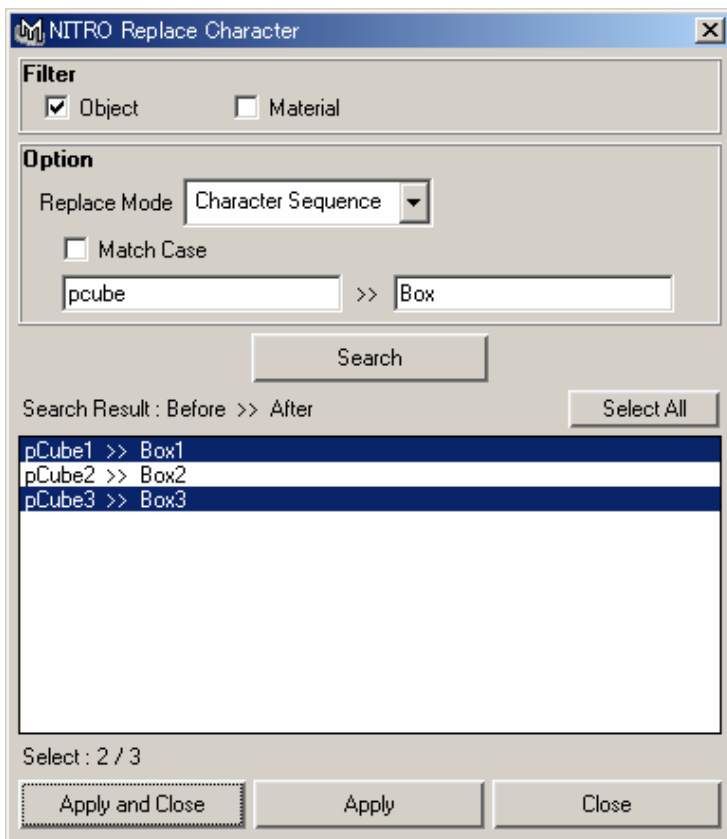


Figure 4-10 The NITRO Replace Character Window

Use the **Filter** check boxes to select an element type (you may select more than one).

Use **Option > Replace Mode** to select a replace mode..

- **Character Sequence**
Replaces the search string in the text box on the left with the replace string in the text box on the right.
When Match Case is checked, the plug-in only returns exact, case-sensitive matches.
When this option is unchecked, it returns any (and all) items that match the search string.
Use the following symbols at the beginning of the search string to limit the search and replace to the beginning or end of the element name.

- “^”
Indicates the beginning of the target element name. If you only enter “^” in the search field, the replace character string is appended before the target element name.
For example:
[[^]cube] >> [box] only replaces instances of [cube] to [box] when “cube” exist at the beginning of an element name.
[^] >> [cube] appends the character string, [cube], to the front of the target element name.
- “\$”
Indicates the end of the element name. If you only enter “\$” in the search field, the replace character string is appended at the end of the targeted element name. For example:
[\$ test] >> [] will delete [test] from any element name that ends with [test].
[\$] >> [test] appends [test] to the end of the target element names.
- Lowercase to Uppercase
Converts all lowercase letters to uppercase letters.
- Uppercase to Lowercase
Converts all uppercase letters to lowercase letters.

When you click the **Search** button, the results of the search (current element names and the element names after replacement) appear in the **Search Result** box. However, elements whose names cannot be changed (lambert1, etc) will not be listed.

From the list, select the element names that you want to replace (will also be selected by Maya). Immediately after you click the **Search** button, all of the elements in the list will be selected. **Ctrl** + Left-click will switch the select status of individual elements. Click the **Select All** button to select all of the elements in the list.

Note: If an element name is not displayed in the “After” column, a blank replace string causes all of the characters in the file name to be deleted, resulting in an element with no file name. These will not be replaced, even if selected. Therefore you must redo the settings.

Replacement actually takes place when you click the **Apply** button. A warning dialog appears if either the new name already exists in the scene or if it is an element name that cannot be used by Maya.

Note: Although an error or warning appears if you can still click Apply while the Attribute Editor is open, the character string is still properly replaced.

4.12 Rename Element Names that Exceed 16 Characters (NITRO Rename Over 16 Characters)

This plug-in searches for and replaces the names of elements (node name, material name, texture image name, texture palette name) which exceed the 16-character limit so that you can export them to intermediate files.

To use this plug-in, select **Start > NINTENDO NITRO-System > NITRO Rename Over 16 Characters**.

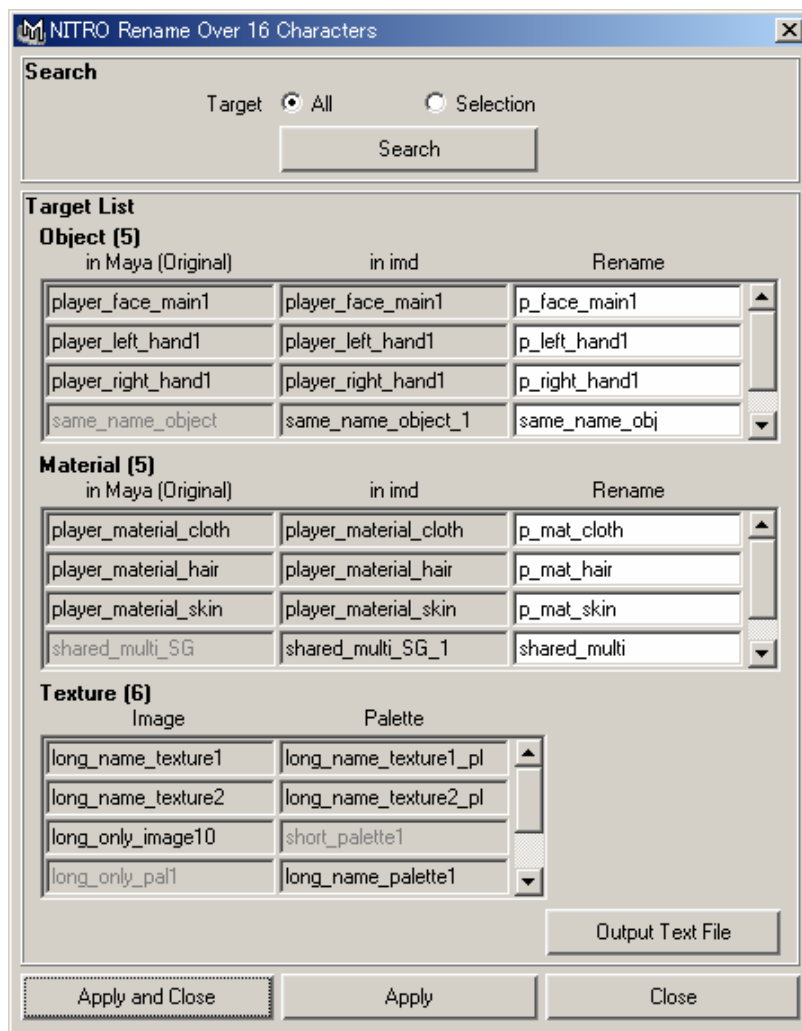


Figure 4-11 The NITRO Rename Over 16 Characters Window

Designate the range parameter by using one of the radio button options in the **Target** section of this window.

- **All** — Select this option if you are going to export an entire scene as intermediate files.
- **Selection** — Select this option if you are going to export only a node and its sub-nodes.

Next, if you chose **Selection** as your Target, use Maya to select the export target node. You need not

select a node if chose **All**.

When you click the **Search** button, a list of the elements set for export to intermediate files whose names exceed 16 characters appears in the **Target List** section (will be selected in Maya). The displayed results are those for the case in which the intermediate file export options “Compress Node” and “Compress Material” are set to “None”, and the option “Output Texture” is set to “Only Used”. If a file node's texture file name is blank, a warning is displayed if the texture file cannot be opened.

For objects and materials: the **in Maya** column lists the names as they are in Maya, the **in imd** column lists the file names as they are in the intermediate file. For textures, the **Image** column lists the texture image names and the **Palette** column lists the texture palette names. Items that do not exceed 16 characters are grayed-out in the display.

In the **Object** section, hovering over an item (moving your pointer over an item and leaving it there momentarily) in the **in Maya** column displays its full pathname as a ToolTip (in a temporary popup box). Hovering over an item in the **Image** or **Palette** column in the Texture section displays the full pathname (for that particular item) as a ToolTip.

Next, type a new name in the **Rename** column. You can *not* use the following names:

- **Names that cannot be used as Maya node names**
- **Names that exceed 16 characters**
- **Names that are already used as node names in the scene.**
- **Names that duplicate other Rename names.**

When you click the **Apply** button, the names are changed. However, elements whose **Rename** names would become blank are not changed. Entries whose names have changed will be selected in Maya and removed from the Target List.

When you click the **Output Text File** button, the current Target List is written to a text file. In the case of textures, the texture file path name is also included in the output. This feature is useful when, for example, you later wish to collectively revise texture file and palette names. It is also useful for later confirming element names before and after changing.

5 Information for Programmers

5.1 Node Matrices in Maya

Maya has two types of nodes that correspond to the imd file's `<node>` element. These are the *transform* node and the *joint* node.

With coordinates multiplied starting from the left, the *transform* node matrix is:

$[S] * [R] * [T]$

[S] = Scale matrix

[R] = Rotate matrix

[T] = Translate matrix

Maya's *joint* node has what is known as a Segment Scale Compensate attribute. When this attribute is OFF, the *joint* node matrix is the same as the *transform* node matrix. But when this attribute is ON, the *joint* node matrix is as follows:

$[S] * [R] * [IS] * [T]$

[IS] = the parent's Scale inverse matrix

The parent's Scale only affects the child's Translate.

When you execute the Intermediate File Output plug-in, the `scale_compensate` attribute – which defines whether to perform scale compensation – is exported to the imd file's `<node>` elements.

Because of this, the program that calculates matrices needs to select one or the other of these two methods in accordance with this attribute for each `<node>` element.

If the `scale_compensate` attribute is set to ON for even one `<node>` element, then the imd file `<model_info>` element's `scaling_rule` attribute will be set to `maya`. Otherwise, the `scaling_rule` attribute will be set to `normal`.

5.2 Node Culling Algorithms

5.2.1 The Algorithm for the “Cull Useless Node” Specification

1. Cull a node if it does not have children and is not used in display of matrix (i.e., the node is not used in the envelope). If the node holds polygons, move them to the root node.
2. Repeat step 1 until there are no more nodes to cull.
3. Lastly, if the root node `world_root` added by the plug-in has one child node, cull `world_root` as well and move any polygons held by `world_root` to its child node.

5.2.2 The Algorithm for the “Merge Useless Node” Specification

1. First perform the same steps taken by the “Cull Useless Node” algorithm.
2. Look at the nodes that remain (other than the root node). If a node's parent node's matrix is not used for display, merge that node's matrix with its parent node matrix and cull the parent node. If that parent node has multiple child nodes, do this merging process for each child node. If the parent node holds polygons, move those polygons to the root node.
3. Repeat step 2 until there are no more nodes to cull.
4. Lastly, also cull the root node if it has one child node and its matrix is not being used for display. Move the root node's polygons to the child node.

5.2.3 Examples of Node Culling

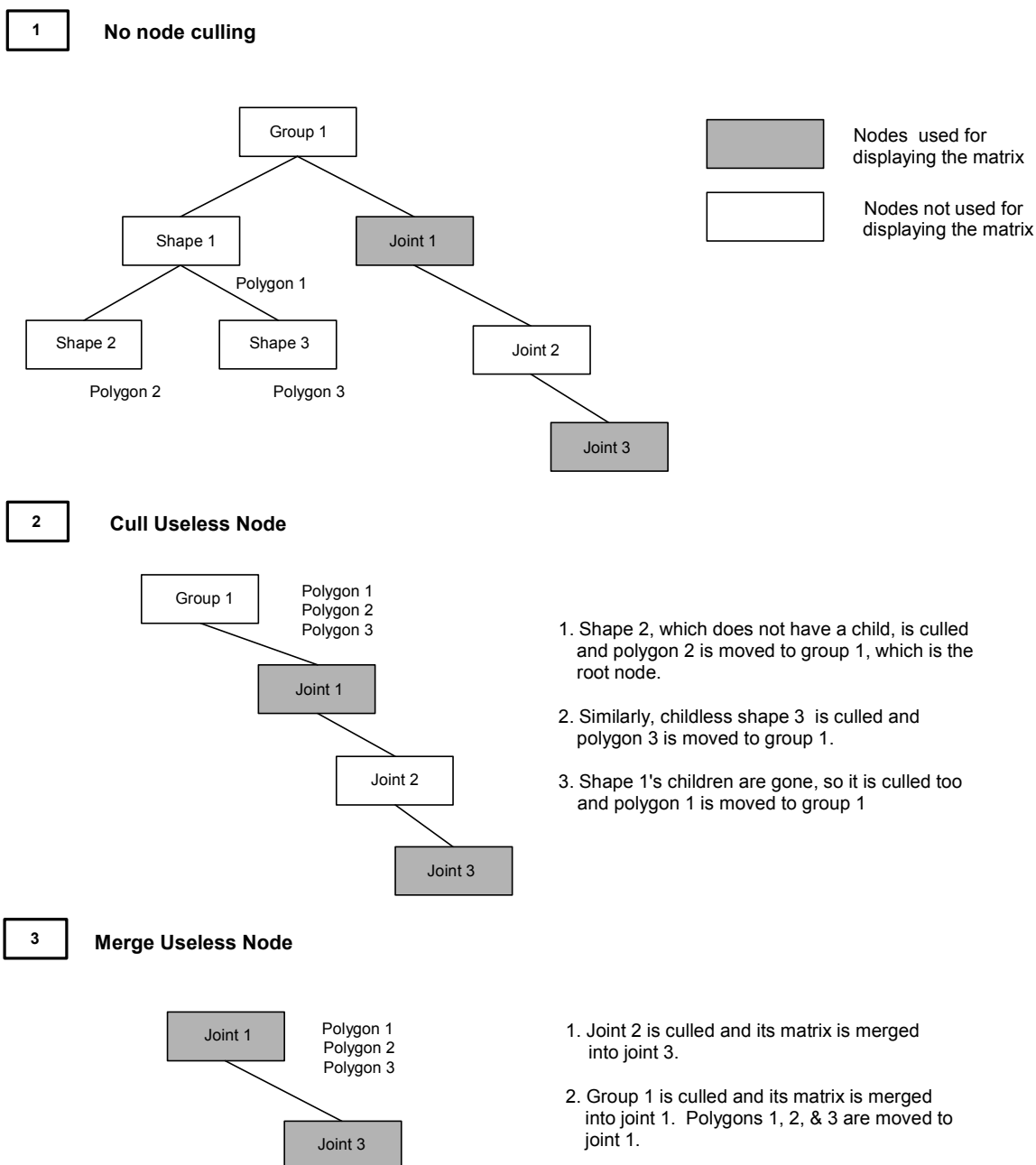


Figure 5-1 Examples of Node Culling

5.3 Texture Matrices in Maya

The method used for creating the texture coordinate transformation matrix for NITRO from the texture Scale value, Rotate value, and Translate value exported from Maya is shown below in C source.

Code 5-1 Texture Matrix

```
// For this texture matrix, the Scale values of ST are Ss, St
// The Rotate value is R, sin(R) is sinR, cos(R) is cosR
// The Translate values of ST are Ts, Tt
// The Texture's image width is W (<tex_image> @ original_width)
// The Texture's image height is H (<tex_image> @ original_height)

const int MTX_SHIFT = 12;
s32 ss_sin = (s32)((s64)Ss * sinR >> MTX_SHIFT);
s32 ss_cos = (s32)((s64)Ss * cosR >> MTX_SHIFT);
s32 st_sin = (s32)((s64)St * sinR >> MTX_SHIFT);
s32 st_cos = (s32)((s64)St * cosR >> MTX_SHIFT);

m[ 0] = ss_cos;
m[ 1] = st_sin * (-H) / W;
m[ 2] = 0
m[ 3] = 0
m[ 4] = ss_sin * W / H;
m[ 5] = st_cos;
m[ 6] = 0
m[ 7] = 0
m[ 8] = 0
m[ 9] = 0
m[10] = 0
m[11] = 0
m[12] = ((-ss_sin - ss_cos + Ss) * W << 3)
        - (s32)((s64)Ss * Ts >> MTX_SHIFT - 4) * W;
m[13] = (( st_sin - st_cos - St + (2 << MTX_SHIFT)) * H << 3)
        + (s32)((s64)St * Tt >> MTX_SHIFT - 4) * H;
m[14] = 0;
m[15] = 1 << MTX_SHIFT;
// ss, st, sinR, cosR, ts, tt are 12-bit fixed-point decimals
// W and H are integers with no decimal
```


5.4 Extra Attributes

The Intermediate File Export Plug-in uses a number of extra attributes. These "custom" attributes all have `nns_` at the start of their name.

Table 5-1 List of Extra Attributes

Type	Node Type	Attribute Name	Attribute Type	Meaning of Values
Light0 enable flag	shadingEngine	<code>nns_lighting</code>	bool	0 = Not affected by Light0 1 = Affected by Light0
Light1 enable flag	shadingEngine	<code>nns_lighting1</code>	bool	0 = Not affected by Light1 1 = Affected by Light1
Light2 enable flag	shadingEngine	<code>nns_lighting2</code>	bool	0 = Not affected by Light2 1 = Affected by Light2
Light3 enable flag	shadingEngine	<code>nns_lighting3</code>	bool	0 = Not affected by Light3 1 = Affected by Light3
Specular Reflection Shininess Table enable flag	shadingEngine	<code>nns_shininess_table</code>	bool	0 = Does not use Specular Reflection Shininess Table 1 = Use Specular Reflection Shininess Table
Fog enable flag	shadingEngine	<code>nns_fog</code>	bool	0 = Does not apply fog 1 = Apply fog
Wireframe display flag	shadingEngine	<code>nns_wire_mode</code>	bool	0 = Wire Frame display ON 1 = Wire Frame display OFF
Decal polygon depth test flag	shadingEngine	<code>nns_depth_test_decal</code>	bool	0= Does not do depth test for decal polygons 1= Does depth test for decal polygons
Translucent polygon depth value update flag	shadingEngine	<code>nns_xlu_update_depth</code>	bool	0= Does not update depth buffer when rendering translucent polygons 1= Updates depth buffer when rendering translucent polygons
1-dot polygon rendering flag	shadingEngine	<code>nns_render_1_pixel</code>	bool	0= Does not render 1-dot polygons 1= Renders 1 dot polygons
FAR clipping flag	shadingEngine	<code>nns_far_clip</code>	bool	0= Deletes if intersects FAR plane 1= Clips if intersects FAR plane
Polygon ID	shadingEngine	<code>nns_poly_id</code>	short	Polygon ID value (0—63)
Polygon's display face	shadingEngine	<code>nns_disp_face</code>	enum	0 = Display front face 1 = Display back face 2 = Display both faces

Type	Node Type	Attribute Name	Attribute Type	Meaning of Values
Polygon mode	shadingEngine	nns_poly_mode	enum	0 = Modulation mode 1 = Decal mode 2 = Toon / Highlight shading 3 = Shadow polygon
Texture coordinates transform mode	shadingEngine	nns_tex_gen_mode	enum	0 = Do not transform texture coordinates 1 = TexCoord source 2 = Normal source 3 = Vertex source
Texture coordinate output flag for when the texture coordinate conversion mode is Normal or Vertex	shadingEngine	nns_tex_gen_st_src	enum	0 = Output polygon's texture coordinates 1 = Do not output polygon's texture coordinates.
Matrix that influences texture coordinate conversion	shadingEngine	nns_tex_effect_mtx	matrix	4x4 matrix
T value used for texture coordinate transformation	shadingEngine	Nns_tex_gen_t	float	T value (-2048—2047.9375)
Material compression-disable flag	shadingEngine	nns_no_compress	bool	0 = Compression OK 1 = No compression
Use polygon rendering priority flag	shadingEngine	nns_use_render_priority	bool	0= Does not use rendering priority (Don't care) 1= Uses rendering priority
Polygon rendering priority	shadingEngine	nns_render_priority	short	Rendering priority value (1-255)
Billboard	transform	nns_billboard	enum	0 = None 1 = Billboard 2 = Y-axis billboard
Node culling-disable flag	transform	nns_no_cut	bool	0 = Culling OK 1 = Do not cull
Frame Extension list for texture pattern animation	file	nns_fe_list	string	List of numbers to forcedly export

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