PVRGeoPOD

User Manual

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1. Introduction

PVRGeoPOD is an exporter plugin for Autodesk Maya, Autodesk 3ds Max and Blender. It exports 3D geometry and scene data as the PowerVR Object Data (POD) format, which is PowerVR's optimized deployment file format. PVRGeoPOD is also available as a standalone application designed to convert from Collada's Digital Asset Exchange (DAE) format to the POD format. This standalone application comes in both graphical and command-line versions and is provided for where a developer's 3D modeller does not have a compatible plugin.

1.1. Supported Features

Some of the notable features of PVRGeoPOD include:

- Skinned meshes.
- Bone batching based on matrix palette size.
- Data format choice (store data as float, byte, unsigned int, etc.).
- Interleaving of vertex data if desired.
- Mesh instancing.
- Multiple texture coordinate sets.
- Parented nodes.
- Polygon stripping.
- Polygon and vertex sorting.
- Tangent space generation.
- Custom user data (plugins only).

1.2. Limitations

The following features are not supported in PVRGeoPOD:

- UV animation.
- Vertex animation.
- Splines.
- Non-Uniform Rational Basis Spline (NURBS).
- Per object culling information.
- Physique modifier (Autodesk 3ds Max only).

2. Installation

2.1. Compatibility Information

2.1.1. Autodesk 3ds Max

Table 1 lists compatible Autodesk 3ds Max plugins.

Table 1. Compatible Autodesk 3ds Max plugins

Plug-in	Autodesk 3ds Max release	"igame.dll" version
3dsmax\12\Windows_x86_32\PVRGeoPOD.dle	2010	12.0.0.106
	2011	13.0.0.94 13.0.0.104
	2012	14.0.0.121
3dsmax\12\Windows_x86_64\PVRGeoPOD.dle	2010 (x64)	12.0.0.106
	2011 (x64)	13.0.0.94 13.0.0.104
	2012 (x64)	14.0.0.121
3dsmax\15\Windows_x86_32\PVRGeoPOD.dle	2013	15.0.0.347 15.5.121.0 15.6.164.0
3dsmax\15\Windows_x86_64\PVRGeoPOD.dle	2013 (x64)	15.0.0.347 15.5.121.0 15.6.164.0
	2014 (x64)	16.0.420.0 16.1.178.0 16.2.475.0 16.3.253.0 16.5.277.0
	2015 (x64)	17.0.630.0 17.1.149.0 17.2.259.0 17.3.374.0

2.1.2. Autodesk Maya

Table 2 lists compatibility details with versions of Autodesk Maya.

Table 2. Autodesk Maya compatibility details

Autodesk Maya version	Windows		OS X	
	32-bit	64-bit	32-bit	64-bit
2010	✓	✓	✓	
2011	✓	✓	✓	✓
2012	✓	✓		✓
2013	✓	✓		✓
2014		✓		✓
2015		✓		✓

2.1.3. Blender

Blender versions 2.59+ are currently compatible.

2.2. Installation from Installer

PVRGeoPOD can be installed from the PowerVR SDK installer:

1. Navigate to the PowerVR Insider webpage (powervrinsider.com) and download the SDK.
2. Launch the installer and follow the on-screen instructions.
3. Once the SDK has been successfully installed, PVRGeoPOD will be available in:

```
<InstallDir>\PVRGeoPOD
```

This folder contains the plugin files. Once these files have been located they must be installed into the plugin system for the respective application. Installation instructions for each of the supported platforms are highlighted next for cases where the user has decided not to auto-install the plugins using the PowerVR Graphics SDK installer or for cases where the installer was unable to successfully install the said plugins.

2.3. Manual Installation

2.3.1. Qt Installation

Some plugins are bundled with a series of Qt libraries, available in the same folder as the plugin. It is important that these Qt libraries be placed in the correct location so that the GUI for the plugin can function correctly. If no Qt libraries are present then they are not required and only the plugin should be copied:

- **For Windows**: The libraries must be placed local to the Autodesk 3ds Max, Autodesk Maya or Blender executable.
- **For Linux**: The location of the libraries must be set with `LD_LIBRARY_PATH`.
- **For OS X**: The libraries must be placed in the same folder as the plugin.

2.3.2. Installation for Autodesk 3ds Max

Copy:

```
PVRGeoPOD.dle
```

To:

```
<3DSMAX_DIR>\plugins\
```

Copy:

```
Qt Dlls
```

To:

```
 <3DSMAX_DIR>\
```

2.3.3. Installation for Autodesk Maya

Windows

Copy:

```
<VERSION>\Windows_x86_*\PVRGeoPOD_v<VERSION>.mll
```

And any Qt files to:

```
<MAYA_DIR>\bin\plug-ins\
```

Copy:

```
Qt Dlls
```

To:

```
<MAYA_DIR>\
```

OS X

Copy:

```
<VERSION>/OSX_x86*/PVRGeoPOD_v<VERSION>.bundle
```

And any Qt files to:

```
/Users/Shared/Autodesk/maya/<MAYA_VERSION>/plug-ins/
```

Once the plugin has been installed it must be activated in the Autodesk Maya Plug-in Manager.

2.3.4. Installation for Blender

Windows

Copy:

```
PVRGeoPOD.dll
PVRGeoPODScript.py
```

To the Blender `Add-ons` folder (run `bpy.utils.script_paths("addons")` for location).

Linux

Copy:

```
libPVRGeoPOD.so
PVRGeoPODScript.py
```

And any Qt files to the Blender `Add-ons` folder (run `bpy.utils.script_paths("addons")` for location).

OS X

Copy:

```
libPVRGeoPOD.dylib
PVRGeoPODScript.py
```

And any Qt files to the Blender `Add-ons` folder (run `bpy.utils.script_paths("addons")` for location).

Once these files have been copied, the plugin must be activated in user preferences, under the section `Add-Ons`.

3. File Export and Conversion

3.1. Available File Formats

3.1.1. POD File

PVRGeoPOD exports data to POD files. The PowerVR SDK Tools library contains functions and classes to use such files in applications. See Section 6 for examples of their use.

3.1.2. Header/Source File

PVRGeoPOD can export the binary POD file directly to a C++ header file (H) or a C++ source file (CPP) as if it had been wrapped using the PowerVR SDK Filewrap utility. The PowerVR SDK contains tools to use POD file data from a header or source file. Further details can be found in Section 6.

Note: For more information regarding the Filewrap utility, consult the “Filewrap User Manual”.

3.1.3. POD vs. Header/Source File

A quick comparison of POD vs. header/source files is highlighted next:

- **Memory footprint**: POD files have a smaller memory footprint. Once a POD file has been copied into memory, the vertex data can be copied into hardware-friendly buffers, e.g., Vertex Buffer Object and Vertex Buffer. As the graphics API has its own copy of the data, the original data can be released as either the whole POD file or just the vertex data, if other information from the file is still required.
- **Flexibility**: A POD file can be changed post-compilation whereas a header/source file must be recompiled into the final binary.
- **Storage**: In situations where the POD file is compiled into the final executable, there will be little size difference between methods. However, a POD file is smaller on disk than a header/source file containing the same information.

3.2. Export a Scene from Autodesk 3ds Max

Once PVRGeoPOD has been installed, it becomes possible to export scenes from Autodesk 3ds Max. To do so, perform the following steps:

1. Open the MAX file that needs to be converted.
2. In the Autodesk 3ds Max application, click `Main Menu -> Export`.
3. Follow the on-screen instructions, as appropriate, to complete the procedure.

3.3. Export a Scene from Autodesk Maya

Once PVRGeoPOD has been installed and activated in the Autodesk Maya Plug-in Manager, it becomes possible to export to the POD format through the following steps:

1. Open the desired Autodesk Maya scene file that needs to be converted.
2. Click `File -> Export All` to export an entire scene or `File -> Export Selection` to export part of it. It is also possible to export using a MEL script. The MEL commands that can be used are as follows:

```
PVRGeoPOD_Export(“filename.pod”)
```

The command exports the scene to `filename.pod` using the previously defined export options.

```
PVRGeoPOD_Export(“filename.pod”, “optionsfilename.txt”)
```

The command exports the scene to `filename.pod` using the export options defined in `optionsfilename.txt`.

```
PVRGeoPOD_Export(“filename.pod” “optionsfilename.txt”, “selected”)
```

The command exports the currently selected meshes to `filename.pod` using the export options defined in `optionsfilename.txt`.

3. Follow any remaining on-screen instructions, as appropriate, to complete the procedure.

3.4. Export a Scene from Blender

Once PVRGeoPOD has been installed and activated in Blender’s plugin manager, it becomes possible to export scenes through the following steps:

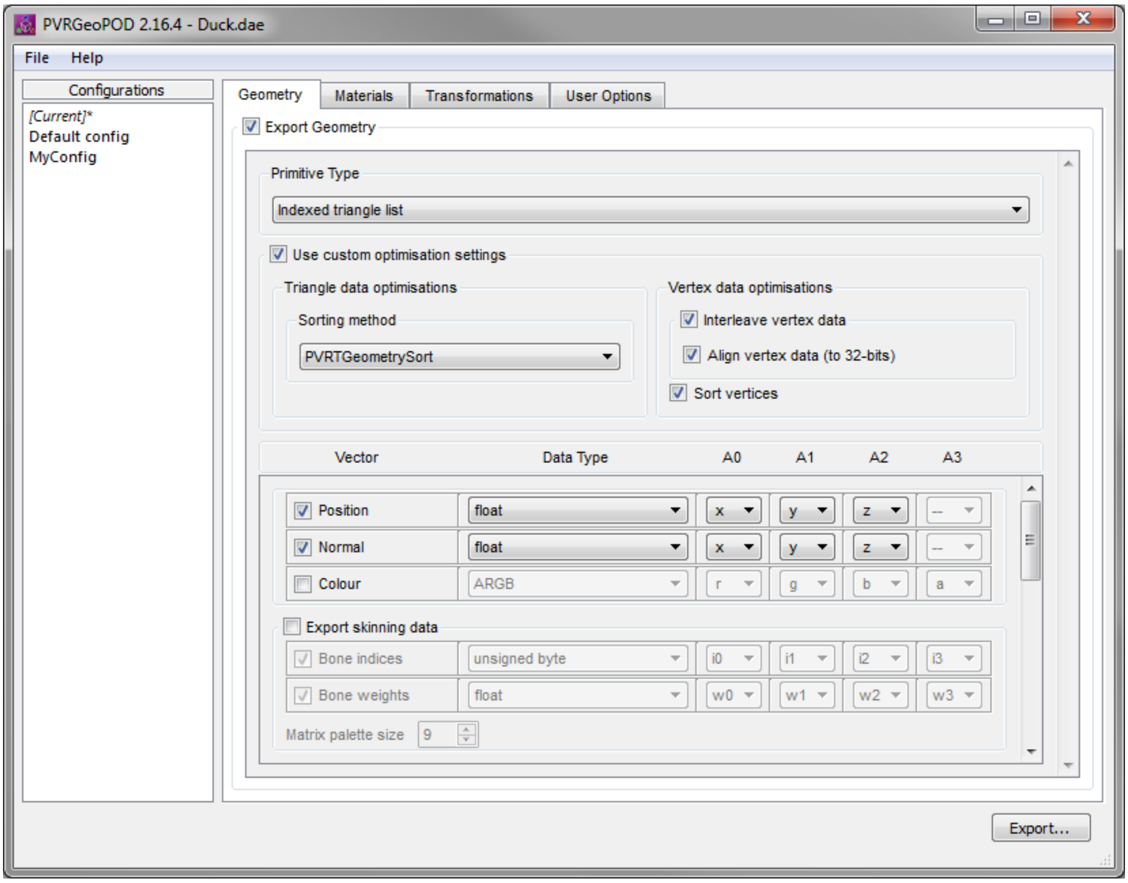
1. Open the BLEND file that needs to be converted.
2. In the Blender application, click `File -> Export -> PVRGeoPOD (.pod/.h/.cpp)`.
3. Follow the on-screen instructions, as appropriate, to complete the procedure.

3.5. Convert from a Collada File

In order to convert a Collada (i.e., DAE) file to a POD file, perform the following steps:

1. Launch the PVRGeoPOD interface (Figure 1).
2. Open the desired Collada file by browsing to it using the `File -> Open` option.
3. Set the required export options. A complete list of the available options is provided in Section 4.
4. Click the `Export` button to convert and save the file. A dialog box will then open to allow a location to be specified for the converted file.
5. Specify the location of the POD file to be saved. After the file is saved, the export status of the file will be summarized on PVRGeoPOD interface.

Note: To verify that a given COLLADA file adheres to the COLLADA schema, use the xmllint command-line application. More details about this application can be found here.



[Current]*
Default config
MyConfig

☑ Export Geometry

Primitive Type: Indexed triangle list

☑ Use custom optimisation settings

Triangle data optimisations — Sorting method: PVRTGeometrySort

Vertex data optimisations: ☑ Interleave vertex data ☑ Align vertex data (to 32-bits) ☑ Sort vertices

Vector	Data Type	A0	A1	A2	A3
☑ Position	float	x	y	z	--
☑ Normal	float	x	y	z	--
□ Colour	ARGB	r	g	b	a

□ Export skinning data

☑ Bone indices	unsigned byte	i0	i1	i2	i3
☑ Bone weights	float	w0	w1	w2	w3

Matrix palette size 9

Figure 1. PVRGeoPOD user interface

3.5.1. Limitations

The following limitations exist when converting from a Collada file:

- Only meshes constructed from triangles, convex polygons, and polylists are supported.
- Animations represented by curves are not supported.
- Skinned animations may not always export correctly. This varies by exporter but has been confirmed to work with OpenCOLLADA for Autodesk 3ds Max.

3.5.2. Command-Line

The PVRGeoPOD standalone command-line utility can be called directly as follows:

```
PVRGeoPODCL –i=<input file> -o=<output file> -cs=<ogl, d3d>
```

All of the options available in the GUI utility are available in the command-line version via a series of flags or from the command-line as follows:

```
PVRGeoPODCL /?
```

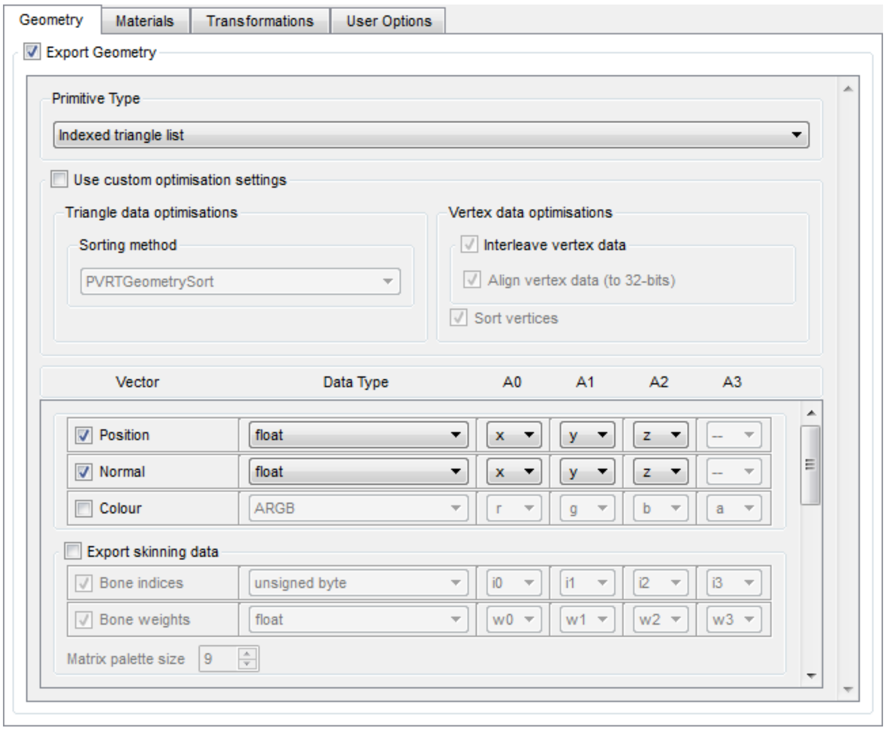
Note: A full list of the flags can be found in Appendix B.

4. PVRGeoPOD Options

The PVRGeoPOD user interface (see Figure 1) contains a range of options that can be used during the conversion and export to the POD file format. Explanations for the options are also available in the interface itself by using the tooltip functionality. The available options to use are fully explained in this section of the user manual.

4.1. Geometry Options

Geometry option settings are adjusted using the `Geometry` tab in PVRGeoPOD interface (Figure 2). Table 3 lists the general geometry options.



☑ Export Geometry

Primitive Type: Indexed triangle list

□ Use custom optimisation settings

Triangle data optimisations
Sorting method: PVRTGeometrySort

Vertex data optimisations
☑ Interleave vertex data
☑ Align vertex data (to 32-bits)
☑ Sort vertices

Vector	Data Type	A0	A1	A2	A3
☑ Position	float	x	y	z	--
☑ Normal	float	x	y	z	--
□ Colour	ARGB	r	g	b	a

□ Export skinning data

☑ Bone indices	unsigned byte	i0	i1	i2	i3
☑ Bone weights	float	w0	w1	w2	w3

Matrix palette size 9

Figure 2. Geometry tab in PVRGeoPOD interface

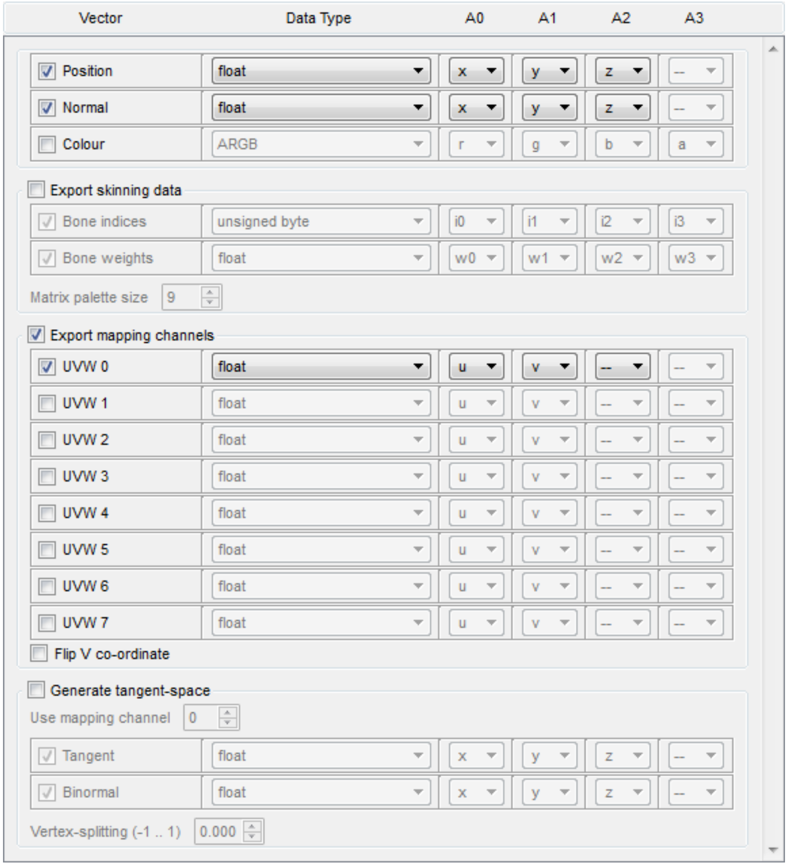
Table 3. General geometry export options

Option	Description
`Export Geometry`	This checkbox must be ticked for geometry information to be exported.
`Primitive Type`	When targeting PowerVR hardware, a performance improvement can be gained by ensuring that the primitives are in the form of a `Triangle List` that is `Indexed`. The other option (`Triangle Strips`) produces additional draw calls and thus can introduce unwanted overhead.
`Use custom optimisation settings`	PVRGeoPOD has a number of default export settings that are recommended for most use cases. If any of these settings require changing, this option must be ticked.

Option	Description
`Triangle data optimisations: Sorting method`	The correct `Sorting Method` can provide a performance improvement. The specific sorting algorithm to use varies with platform, however, the following are suggested: • If PowerVR MBX hardware is being targeted use `PVRTTriStrip`. • If PowerVR Series5 or Series6 hardware is being targeted use `PVRTGeometrySort`. • If the DirectX API is being targeted use either `PVRTGeometrySort` or `D3DX`.
`Vertex data optimisations: Interleave vertex data`	Interleaving vertex data is an optimization that takes the vectors generated for the position, normals, UV coordinates, etc., and places them into a single large array. Tick this option to use this setting.
`Vertex data optimisations: Align vertex data (to 32-bits)`	This option when ticked, pads the interleaved array so that each attribute for each vertex falls on a 32-bit boundary. On some hardware this will provide a small performance improvement due to the overhead involved in accessing memory that does not align correctly with the said boundary.
`Vertex data optimisations: Sort vertices`	This option when ticked optimizes the vertex list to improve vertex-read memory cache. The option is only available in Windows on machines where DirectX9 is present.

Figure 3 illustrates the options that appear in the section below the general options. The section displays the vectors to be exported, their format, how many dimensions a given vector uses, and any other additional option related to a given set of vertex data. Some variables can be fine-tuned, such as the individual dimensions that should be exported and the specific data types to be used. Table 4 provides a list of the participating vertex data export options.

Data that is greyed out will not be exported and any area that is not greyed out is only exported if information exists to fill it. Controlling the data types can be done from the options under the `Data Type` column. A list of data types can be found in Table 5.



Vector	Data Type	A0	A1	A2	A3
☑ Position	float	x	y	z	--
☑ Normal	float	x	y	z	--
□ Colour	ARGB	r	g	b	a

□ Export skinning data

☑ Bone indices	unsigned byte	i0	i1	i2	i3
☑ Bone weights	float	w0	w1	w2	w3

Matrix palette size 9

☑ Export mapping channels

☑ UVW 0	float	u	v	--	--
□ UVW 1	float	u	v	--	--
□ UVW 2	float	u	v	--	--
□ UVW 3	float	u	v	--	--
□ UVW 4	float	u	v	--	--
□ UVW 5	float	u	v	--	--
□ UVW 6	float	u	v	--	--
□ UVW 7	float	u	v	--	--

□ Flip V co-ordinate

□ Generate tangent-space

Use mapping channel 0

☑ Tangent	float	x	y	z	--
☑ Binormal	float	x	y	z	--

Vertex-splitting (-1 .. 1) 0.000

Figure 3. Vertex data options in the Geometry tab

Table 4. Vertex data export options in the Geometry tab

Option	Description
`Position`	Vertex position. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Normal`	Vertex normal. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Colour`	Vertex colour. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Export skinning data`	Tick this option if skinning is required.
`Export skinning data: Bone indices`	Bone indices details to be exported. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Export skinning data: Bone weights`	Bone weights details to be exported. The data type as well as the dimensions that need to be exported can be set as appropriate.

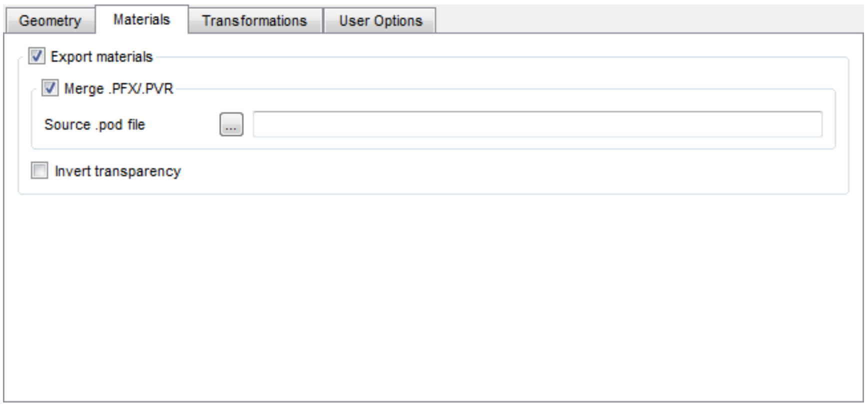
Option	Description
`Export skinning data: Matrix palette size`	This option represents the number of matrices that can affect a specific mesh. By default, this value is equal to `9` in order to support APIs which limit the matrix palette size, e.g., OpenGL ES 1.1. If the number of matrices affecting a mesh is greater than the `Matrix Palette Size` the mesh is split into batches which use fewer matrices per batch. The side effect is that more meshes produce more draw calls and thus a greater overhead. *Note: In some cases when performing skinning or animation the default way of representing transformations in the POD format is not sufficient for skinning. This can cause rendering issues. If this occurs with a scene, ticking* `Export transformations as matrices` *can rectify the situation (see Section 4.3).*
`Export mapping channels`	The mapping channel options consist of the settings for UV coordinate channels, their associated data types, and dimensions. Tick this option if UV coordinates are to be exported.
`Export mapping channels: UVW<number>`	Specific mapping channel to be exported. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Export mapping channels: Flip V co-ordinate`	This option flips the V coordinate in the UV texture. It is used when textures are to behave in the same way as a 'render to texture' target in OpenGL. If both Direct3D and OpenGL are being targeted, this option is unlikely to be desirable.
`Generate tangent space`	The tangent space options consist of the settings for both of the binormal and tangent channels, their associated data types, and dimensions. This option must be ticked if tangents and binormals are to be exported.
`Generate tangent space: Use mapping channel`	The value of this option determines which of the possible eight UV channels are used to create the tangent space data.
`Generate tangent space: Tangent`	Tangent details to be exported. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Generate tangent space: Binormal`	Binormal details to be exported. The data type as well as the dimensions that need to be exported can be set as appropriate.
`Generate tangent space: Vertex splitting (-1 .. 1)`	This option can have a value between `-1` and `1`, representing a threshold value. If multiple faces share a vertex and the difference between the directions of those faces is greater than the threshold, a new vertex is created for each face with separate tangent space data.

Table 5. Data types available under the Data Type column

Data type
ABGR
ARGB
RGBA
D3DCOLOR
DEC3N
fixed 16.16
float
int
short
short, normalised
UBYTE4
unsigned byte
unsigned byte, normalised
unsigned int
unsigned short
unsigned short, normalised
byte
byte, normalised

4.2. Material Options

Material option settings are adjusted using the `Materials` tab in PVRGeoPOD interface (Figure 4). Table 6 lists the material options available.



☑ Export materials

☑ Merge .PFX/.PVR

Source .pod file ...

□ Invert transparency

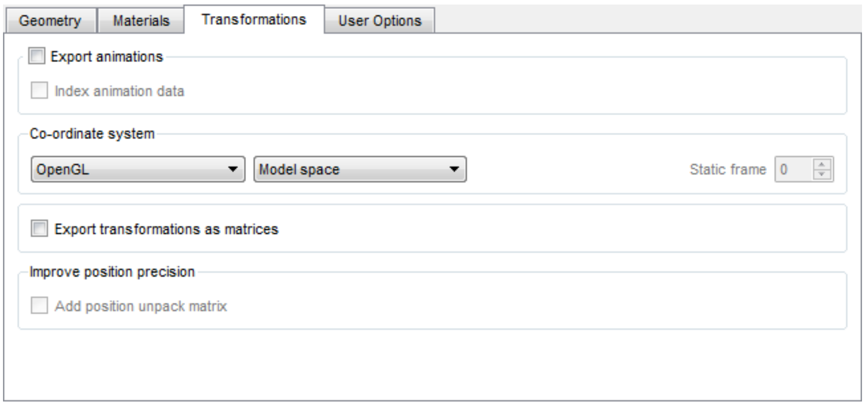
Figure 4. Materials tab in PVRGeoPOD interface

Table 6. Material export options

Option	Description
`Export materials`	This option must be ticked if materials are to be exported.
`Merge .PFX/.PVR`	In cases where a POD file has been edited and PVR or PFX files have been added, it is possible to re-export the geometry from the original file back into the edited POD file. To do this tick `Merge .PFX/.PVR`, click the ellipsis (`...`) button to browse to and open the POD file to be updated. Once all export options are set and the export has been completed the POD file will contain the new geometry.
`Source .pod file`	Use this option to browse and open the desired file.
`Invert transparency`	This option inverts the transparency value of the materials being exported, e.g., if the transparency is in the range of `0 < n < 1` all values will become `1-n`, post export).

4.3. Transformation Options

Transformation option settings are adjusted using the `Transformations` tab in PVRGeoPOD interface (Figure 5). Table 7 lists the transformation options available.



□ Export animations

□ Index animation data

Co-ordinate system

OpenGL

Model space

Static frame 0

□ Export transformations as matrices

Improve position precision

□ Add position unpack matrix

Figure 5. Transformations tab in PVRGeoPOD interface

Table 7. Transformation export options

Option	Description
`Export animations`	This option must be ticked if animations are to be exported.
`Export animations: Index animation data`	Instead of storing transformation data per keyframe, ticking this option forces PVRGeoPOD to create a list of the transformations instead. The transformations are then referred to by an index into that list within each keyframe. In instances where a small number of animations are being performed repeatedly, this can produce a smaller POD file. *Note: In some cases when performing skinning or animation the default way of representing transformations in the POD format is not sufficient for skinning. This can cause rendering issues. If this occurs with a scene, ticking* `Export transformations as matrices` *can rectify the situation (see Section 4.3).*
`Co-ordinate system`	There are two dropdown boxes in this section. The first one contains two options, `OpenGL` and `DirectX`, and must be set to match the API being targeted. The second dropdown box contains the options `World Space` and `Model Space`. These represent the 'spaces' that the file will be exported into. This option only becomes available when no animation is present. When animation is present the export will always be in model space.
`Co-ordinate system: Static frame`	If no animation is to be exported and `World Space` has been selected, a single frame can be selected for export. This allows for certain transformations to be 'baked in'.
`Export transformations as matrices`	When this option is selected, all transformations will be exported as matrices rather than as positions, quaternions and scale. *Note: In some cases when performing skinning or animation the default way of representing transformations in the POD format is not sufficient for skinning. This can cause rendering issues. If this occurs with a scene, ticking* `Export transformations as matrices` *can rectify the situation (see Section 4.3).*
`Improve position precision: Add position unpack matrix`	If a non-float data type (e.g., `ushort`) is set for position (see Section 4.1), this option can be ticked to improve the precision of the position data. This is done by using the entire range of the data type to store the information. A matrix is provided to unpack the data back to the correct values.

4.4. User Options

User option settings are adjusted using the `User Options` tab in PVRGeoPOD interface (Figure 6). Table 8 lists the user options available.

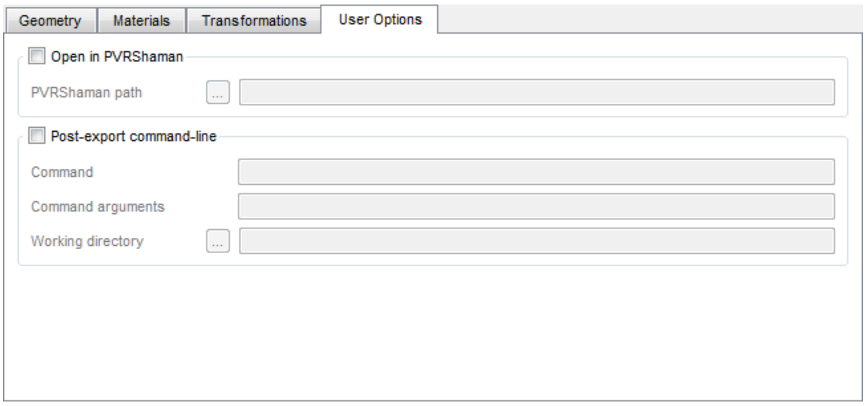


Figure 6. User Options tab in PVRGeoPOD interface

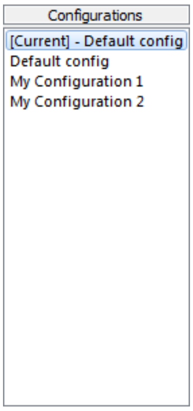
Table 8. User option settings

Option	Description
`Open in PVRShaman`	Tick this option to specify a path to PVRShaman. This indicates that once the export is complete, the resulting POD file will be opened in PVRShaman.
`PVRShaman path`	Use this option to browse to the path of PVRShaman.
`Post-export command-line`	Tick this option to be able to use the participating settings. The settings allow the specification of a separate program to be run upon successful completion of an export.
`Command`	This option can be used to specify the path to the executable or the command line call for the command to run.
`Command arguments`	This option can be used to specify the arguments that are to be passed to the program, specified in `Command` and `Command arguments`. If the phrase `%POD` is found in the argument list it will be replaced with the absolute file path of the exported POD file.
`Working directory`	This option can be used to specify the directory in which the program specified by `Command` is to be run.

Option	Description
`Export user data`	[Plugins only] This option allows the addition of user data to POD files by using MAXScript or MEL. The user defined script should implement the functions: • `DefineNodeUserData` • `DefineMaterialUserData` • `DefineSceneUserData` These functions will be called by the exporter and their return values will be stored in the POD file. Examples can be seen in Section 5.

4.5. Using Configurations

PVRGeoPOD includes support for custom configurations, which are groups of settings that can be saved and reused to speed up the file export process. The `Configurations` section is available at the left hand side of the interface (Figure 7).



Configurations

[Current] - Default config
Default config
My Configuration 1
My Configuration 2

Figure 7. Using configurations

4.5.1. Save a Configuration

To save a new configuration, perform the following steps:

1. Select the desired export settings by switching to the various tab options in the PVRGeoPOD interface.
2. Under the `Configurations` section of the interface, right-click the option identified as `[Current]`. This will open an action menu.
3. From the menu, select the option `Save As…` This will open the `Enter Name` dialog box for inputting the name of the new configuration.
4. Type in the name of the configuration and click the `OK` button in the dialog box. The configuration will then appear under the `Configurations` section.

4.5.2. Make a Configuration Active

If multiple configurations have been created and a specific one needs to be chosen from the list for a particular export task, it is possible to switch to the required configuration and make it active. To do so, follow the steps:

1. Identify the desired configuration in the list under the `Configurations` section.
2. Right-click the configuration. This will open an action menu.
3. From the menu, select the option `Set as [Current]`. This will then set the chosen configuration as active and will appear as the first item in the list, prefixed with the `[Current]` tag.

4.5.3. Rename a Configuration

Existing user-defined configurations can be renamed on demand by following these steps:

1. Identify the desired configuration in the list under the `Configurations` section.
2. Double-click the configuration. Alternatively, right-click the configuration and select the option `Rename`.
3. Enter the new name of the configuration.

4.5.4. Export a Configuration

Configurations can be exported in order to have them saved as either TXT of CFG files for reuse and portability. To export a configuration, perform the following steps:

1. Identify and select the desired configuration in the list under the `Configurations` section.
2. Right-click the configuration. This will open an action menu.
3. Select the option `Export to file`. This will open a dialog box from which the save format (TXT or CFG) and location of the file can be selected.
4. Click the `Save` button in the dialog box to complete the procedure.

4.5.5. Import a Configuration

Configurations can be imported on demand for use in PVRGeoPOD. To import a configuration, perform the following steps:

1. Right-click in an empty area of the `Configurations` section. This will open an action menu.
2. Select the option `Import from file`. This will open a dialog box from which the saved file can be selected.
3. Browse and select the required file.
4. Click the `Open` button in the dialog box to complete the procedure.

5. Using MAXScript and MEL

5.1. Overview

The `Export user data` option (see Table 8) allows the user to apply a script to export any desired data. As previously explained, the location of this script must be entered or browsed to, in order for this feature to function. The user-defined script should implement the following functions:

- `DefineNodeUserData`
- `DefineMaterialUserData`
- `DefineSceneUserData`

These functions will be called during the export process: `DefineNodeUserData` when exporting an object to a POD node; `DefineMaterialUserData` when exporting a Material; `DefineSceneUserData` when exporting a full scene.

`DefineNodeUserData` will be passed a node ID; `DefineMaterialUserData` will be passed a material ID; `DefineSceneUserData` will be passed nothing. The return value of each script will be written into the `pUserData` field of the `SPODNode`, `SPODMaterial`, or `SPODScene` as appropriate. Once the export process is complete it is the user’s responsibility to read the `pUserData` field and parse the exported data correctly. Examples of using MAXScript and MEL are provided next.

5.2. MEL

```
// Note: The return type of the procedures can be changed if desired

global proc string DefineNodeUserData(string $nodeid)
{
        // Return the node name and class type as a string to be included in the POD node for
nodeid
        string $type = `nodeType $nodeid`;
        return $nodeid + " is of type " + $type;
}

global proc string DefineMaterialUserData(string $matid)
{
        /*
        We're going to return the  material colour but we're going to do it
        as a comma seperated string. The first value will be a unique tag to
        identify that we're exporting the colour value. The second value will
        be the material's red colour value, the third green and the final value
        blue.
        */
        string $s = "";
        $s += "3002,";
        float $c[] = `getAttr ($matid + ".color")`;
        $s += $c[0] + "," + $c[1] + "," + $c[2];
        return $s;
};


global proc string DefineSceneUserData()
{
        /*
        Anything returned from this function will be included in the SPODScene's user data.
        This is for information that doesn't belong with a node or a material.
        */
        return "Extra global data";
}
```

5.3. MAXScript

```
function DefineNodeUserData nodeid =
(
        /* Return the node name and class type as a string to
        be included in the POD node for nodeid */
        node = maxOps.getNodeByHandle nodeid
        str = stringstream ""
        format "% is of type " node.name  to:str
        print (superClassOf node) to:str
        str as string
)

function DefineMaterialUserData matid subid =
(
        mat = sceneMaterials[matid]
        superClassOf mat

        /* Is our material a subobject material? */
        if isKindOf mat multimaterial then
        (
                /* If it is a subobject material return its name and parent material name */
                str = stringstream ""
                submat = mat.materialList[subid]
                format "%:%" mat.name submat.name to:str
                return str as string
        )

        /*
        Our material is just a material. We're going to return the diffuse colour
        but we're going to do it in a structured way using a MAXScript array. The
        first value will be a unique tag to identify that we're exporting the
        diffuse value. The second value will be the data size and the third vale
        is the material's diffuse value.
        */

        matdata = #()
        append matdata 3004                  /* The POD tag for diffuse */
        append matdata (4 * 3)               /* The size of the diffuse data (3 floats) */
        append matdata mat.diffuse           /* The diffuse data */

        /* return our data */
        matdata
)

function DefineSceneUserData =
(
        /*
        Anything returned from this function will be included
        in the SPODScene's user data.
        This is for information that doesn't belong with a node or a material.
        */
        "Extra global data"
)
```

6. Using POD Data

POD files can be loaded into PVRShaman, which is the shader composer utility supplied as part of the PowerVR Graphics SDK. For more information on PVRShaman please refer to the “PVRShaman User Manual”. The following are two examples of how to load POD data.

Example of loading a POD file:

```
// Create the model object
CPVRTModelPOD m_model;

// Load the model & fill the object
if(m_model.ReadFromFile(“modelPOD”) != PVR_SUCCESS)
        return false;

// Do stuff

// Free the memory
m_model.Destroy();
```

Example of loading a header/source file:

```
// Include the scene data
#include “modelH”

// Create the model object
CPVRTModelPOD m_model;

// Load the model * fill the object
if(m_model.ReadFromMemory(_model_pod, _model_pod_size) != PVR_SUCCESS)
        return false;

// Do stuff

// Free the memory
m_model.Destroy();
```

7. Contact Details

For further support, visit our forum:
http://forum.imgtec.com

Or file a ticket in our support system:
https://pvrsupport.imgtec.com

To learn more about our PowerVR Graphics SDK and Insider programme, please visit:
http://www.powervrinsider.com

For general enquiries, please visit our website:
http://imgtec.com/corporate/contactus.asp

Appendix A. Block Names

Table 9 lists the block names taken from the `EPODFileName` enumerator in `PVRTModelPOD.cpp`.

Table 9. Block names

Name
ePODFileCamAnimFOV
ePODFileCamera
ePODFileCamFar
ePODFileCamFOV
ePODFileCamNear
ePODFileColourAmbient
ePODFileColourBackground
ePODFileData
ePODFileDataType
ePODFileEndiannessMisMatch
ePODFileExpOpt
ePODFileFlags
ePODFileFPS
ePODFileHistory
ePODFileLight
ePODFileLightColour
ePODFileLightConstantAttenuation
ePODFileLightFalloffAngle
ePODFileLightFalloffExponent
ePODFileLightIdxTgt
ePODFileLightLinearAttenuation
ePODFileLightQuadraticAttenuation
ePODFileLightType
ePODFileMatAmbient
ePODFileMatBlendColour
ePODFileMatBlendDstA
ePODFileMatBlendDstRGB
ePODFileMatBlendFactor
ePODFileMatBlendOpA
ePODFileMatBlendOpRGB
ePODFileMatBlendSrcA
ePODFileMatBlendSrcRGB
ePODFileMatDiffuse

Name
ePODFileMatEffectFile
ePODFileMatEffectName
ePODFileMaterial
ePODFileMatFlags
ePODFileMatIdxTexAmbient
ePODFileMatIdxTexBump
ePODFileMatIdxTexDiffuse
ePODFileMatIdxTexEmissive
ePODFileMatIdxTexGlossiness
ePODFileMatIdxTexOpacity
ePODFileMatIdxTexReflection
ePODFileMatIdxTexRefraction
ePODFileMatIdxTexSpecularColour
ePODFileMatIdxTexSpecularLevel
ePODFileMatName
ePODFileMatOpacity
ePODFileMatShininess
ePODFileMatSpecular
ePODFileMatUserData
ePODFileMesh
ePODFileMeshBin
ePODFileMeshBoneBatchBoneCnts
ePODFileMeshBoneBatchBoneMax
ePODFileMeshBoneBatchCnt
ePODFileMeshBoneBatches
ePODFileMeshBoneBatchOffsets
ePODFileMeshBoneIdx
ePODFileMeshBoneWeight
ePODFileMeshFaces
ePODFileMeshInterleaved
ePODFileMeshNor
ePODFileMeshNumFaces
ePODFileMeshNumStrips
ePODFileMeshNumUVW
ePODFileMeshNumVtx
ePODFileMeshStripLength
ePODFileMeshTan
ePODFileMeshUnpackMatrix

Name
ePODFileMeshUVW
ePODFileMeshVtx
ePODFileMeshVtxCol
ePODFileN
ePODFileNode
ePODFileNodeAnimFlags
ePODFileNodeAnimMatrix
ePODFileNodeAnimMatrixIdx
ePODFileNodeAnimPos
ePODFileNodeAnimPosIdx
ePODFileNodeAnimRot
ePODFileNodeAnimRotIdx
ePODFileNodeAnimScale
ePODFileNodeAnimScaleIdx
ePODFileNodeIdx
ePODFileNodeIdxMat
ePODFileNodeIdxParent
ePODFileNodeMatrix
ePODFileNodeName
ePODFileNodePos
ePODFileNodeRot
ePODFileNodeScale
ePODFileNodeUserData
ePODFileNumCamera
ePODFileNumFrame
ePODFileNumLight
ePODFileNumMaterial
ePODFileNumMesh
ePODFileNumMeshNode
ePODFileNumNode
ePODFileNumTexture
ePODFileScene
ePODFileStride
ePODFileTexName
ePODFileTexture
ePODFileUserData
ePODFileVersion

Appendix B. PVRGeoPOD Command-Line Options

Table 10 provides a list of PVRGeoPOD command-line options and their corresponding example usage and description.

Table 10. PVRGeoPOD command-line options

Option	Example usage and description
`-LoadOptions`	`-LoadOptions=c:\options.cfg`
`-SaveOption`	`-SaveOptions=c:\options.cfg`
`-FixedPoint`	`-FixedPoint=1` to enable
`-FlipTextureV`	`-FlipTextureV=1` to enable
`-Indexed`	`-Indexed=1` to enable
`-Interleaved`	`-Interleaved=1` to enable
`-SortVertices`	`-SortVertices=1` to enable
`-TangentSpace`	`-TangentSpace=1` to enable
`-ExportControllers`	`-ExportControllers=1` to enable
`-IndexAnimation`	`-IndexAnimation=1` to enable
`-ExportGeometry`	`-ExportGeometry=1` to enable
`-ExportMatrices`	`-ExportMatrices=1` to enable
`-ExportMappingChannels`	`-ExportMappingChannels=1` to enable
`-ExportMaterials`	`-ExportMaterials=1` to enable
`-ExportNormals`	`-ExportNormals=1` to enable
`-ExportSkin`	`-ExportSkin=1` to enable
`-ExportVertexColor` `-ExportVertexColour`	`-ExportVertexColor=1` to enable
`-InvertTransparency`	`-InvertTransparency=1` to enable
`-ExportModelSpace`	`-ExportModelSpace=1` to enable
`-TangentSpaceVtxSplit`	`-TangentSpaceVtxSplit=0.000`
`-BoneLimit`	`-BoneLimit=0`
`-cs`	By default PVRGeoPOD converts the coordinate system of the scene to OpenGL. `-cs` allows for the overriding of this default. Example: `-cs=ogl` Valid values: `ogl`, `d3d`
`-PrimitiveType`	`-PrimitiveType=TriList` Valid values: `TriList`, `TriStrips`
`-TriSort`	`-TriSort=None` Valid values: `None`, `PVRTGeometrySort`, `D3DX`, `PVRTTriStrip`

Option	Example usage and description
-PosType	The data type for vertex positions. Example: -PosType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-NorType	The data type for vertex normals. Example: -NorType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-ColorType -ColourType	The data type for vertex colours. Example: -ColorType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-UVWnType	The data type for vertex UVW coordinates (set n). Example: -UVW0Type=float -UVW5=ARGB Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-BinormalType	The data type for binormals. Example: -BinormalType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-TangentType	The data type for tangents. Example: -TangentType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-BoneIdxType	The data type for bone indices. Example: -BoneIdxType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-BoneWtType	The data type for bone weights. Example: -BoneWtType=float Valid values: float, int, unsigned int, ushort, ushortN, RGBA, ARGB, D3DCOLOR, UBYTE4, DEC3N, fixed, ubyte, ubyteN, short, shortN, byte, byteN
-PadDataTo	Pad the vertex data to PadDataTo no. of bytes. The GUI option Align vertex data (see Section 4.1) is functionally equivalent to -PadDataTo=4 Example: -PadDataTo=1 Valid values: 1, 2, 4

Option	Example usage and description
`-Merge`	Merge the output POD file with an existing POD file. This is functionally equivalent to the GUI option `Merge .PFX/.PVR` (see Section 4.2). Example: `-Merge=c:/otherPOD`