

XPU Features and Limitations

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The first phase of XPU delivers a complete feature set for look development. However, some features are not supported yet but will be as XPU matures to replace RIS. Here is a high-level summary of those features supported currently in XPU

General

- The behavior of XPU when it runs out of memory on your GPU: XPU will crash if it runs out of memory on your GPU. If you are running XPU inside of Maya, Houdini, or Blender, this will bring down your application as well. Be sure to save often. We are going to work to mitigate the two biggest causes of this condition.
- If you have more than one GPU, we allow you to specify which GPU to use with XPU but do not yet support the ability to use more than one GPU at the same time.
- XPU is not yet supported on the Mac.

DCCS

- Warnings on the console when rendering to XPU from Katana. There are some warnings you will see on the console about a bad DSO being found for the socket display driver. You can ignore these.
- Picking from "it" does not relay the selection back to RenderMan for Maya
- RenderMan for Maya supports batch rendering to XPU (PxrPathTracer integrator)

Shading

BxDFs, Displacement & Patterns	RIS	XPU	Notes
PxrSurface	? Unknown Attachment	? Unknown Attachment	Some subsurface modes are not available. Subsurface on bump-mapped surfaces has stronger bumps than RIS.
PxrLayerSurface	? Unknown Attachment	? Unknown Attachment	
PxrDisneyBsdF	? Unknown Attachment	? Unknown Attachment	
PxrMarschnerHair	? Unknown Attachment	? Unknown Attachment	
PxrConstant	? Unknown Attachment	? Unknown Attachment	
Lama	? Unknown Attachment	? Unknown Attachment	
Volumes	? Unknown Attachment	? Unknown Attachment	Heterogeneous volumes are supported via aggregate volumes
OSL Patterns	? Unknown Attachment	? Unknown Attachment	PxrDirt and PxrCurvature are not supported
C++ Patterns	? Unknown Attachment	? Unknown Attachment	
Baking	? Unknown Attachment	? Unknown Attachment	
Point Clouds	? Unknown Attachment	? Unknown Attachment	

- Custom Bxdf or Displacement plugins are unsupported.
- MaterialX Lama support will be implemented in a future release.
- Due to differences in how XPU computes derivatives for normals, XPU may compute different results from RIS for bump mapped subdivision surfaces in areas of highly concave curvature, combined with a high bump scale. This happens especially when the bump mapping cannot reasonably approximate the displacement. Note that this difference does not occur with displacement. The issue can be ameliorated by reducing the bump scale.

Patterns & Textures

- There is no support for custom C++ plugins. Patterns written in OSL are supported.
- PxrSeExpr is not supported.
- PxrDirt & PxrCurvature require the trace() OSL call, which is not yet supported.
- Point clouds are not supported.
- PxrBakeTexture and PxrBakePointCloud are not supported.
- Textures with a non square pixel aspect ratio are not supported.

Volumes

- In XPU, the expected workflow for heterogeneous volumes is via aggregate volumes. XPU has limited support for the non-aggregate volume workflow: only homogeneous volumes are supported.
- XPU fully supports volume primitives of type "box" and "blobbydso" (ImplicitField plugins); however, VDB volumes are the optimized preferred choice, and non-VDB volumes will incur a cost for upfront internal conversion to VDB.
- Interior volume aggregates are not currently supported.
- Single scattering support in PxrSurface is not complete in XPU.
 - Renders will be noticeably incorrect after the first bounce off the interior of a closed object.
 - Lights placed inside objects with homogeneous single scattering will not compute the correct shadowing.
 - Intermixing objects with homogeneous single scattering and aggregate volume primitives may not lead to the correct result.
- Deformation motion blur via velocity is supported, but currently requires specification of the velocity grid directly to impl_openvdb.so as the third string parameter. We will also only support velocity that comes directly from a grid, and has not been computed or altered by arbitrary shading. We anticipate lifting some of these restrictions in a future point release.
- Joint sampling is not yet supported, so the convergence of volumes with complicated lighting that requires joint sampling will not be as performant as RIS on a per sample basis.
- Instancing of volumes is not fully supported.

OSL

- In XPU, the first argument to the OSL getbuiltin() shadeop is ignored. You may continue to specify a first argument in order for your shader to remain compatible with RIS, but the distinction between "primvar", "builtin", and "attribute" that exists in RIS does not exist in XPU.
- getattribute() calls asking for geometry primvars (in RIS, getattribute("primvar")) are fully supported.
- getattribute() calls targeting "builtins" (renderer computed quantities that are not directly geometry primvars) are partially supported. Some builtins known to RIS are not currently available in XPU. The most important changes are summarized in the table below. If an alternative is suggested, it means that OSL patterns should be rewritten to use the alternative to be as forward looking as possible, particularly if a OSL global exists.

P	? Unknown Attachment	global P may be preferred
PRadius	? Unknown Attachment	use filterwidth() (scaled to radius if needed)
Po	? Unknown Attachment	
Nn	? Unknown Attachment	use global N
Non	? Unknown Attachment	supported, but only if displacement took place
Ngn	? Unknown Attachment	use global Ng
Naon	? Unknown Attachment	point Po; getattribute("primvar", "P", Po); Naon = normalize(cross(Dx(Po), Dy(Po)));

Tn	? Unknown Attachment	
Vn, VLen	? Unknown Attachment	derive from global I: Vn = -normalize(I); VLen = length(I);
curvature	? Unknown Attachment	
dPdu, dPdv	? Unknown Attachment	use globals dPdu and dPdv
u, v	? Unknown Attachment	globals u and v may be preferred
st	? Unknown Attachment	
du, dv	? Unknown Attachment	use 0.5 * Dx(u), 0.5 * Dy(v)
dPdttime	? Unknown Attachment	
time	? Unknown Attachment	use global time
id, id2	? Unknown Attachment	

- The only `getattribute("attribute", ...)` lookups that are supported in XPU are "user" attributes (e.g. `getattribute("attribute", "user:foo", foo)`) and "user" options.
- `getattribute("context")` and `getattribute("rendererInfo")` queries are not supported in XPU.
- `trace()` is not currently supported. Support for a single level of recursion will be added in a future release.
- Dynamic string construction is not supported.
- It is possible in some cases that strings within OSL patterns are not properly constant folded, resulting in errors at runtime.
- Dynamic path construction in your own patterns is not supported, but please note that we **do** support the following path tokens `<UDIM>`, `<u>`, `<v>`, `<U>`, `<V>` and `<primstr:varname>` that will result in a "dynamic" path to your textures. `<primstr:varname>` can be used to reference the value in a constant primvar or user attribute to build a dynamic path

Geometry

	RIS	XPU	Notes
Subdivision Surfaces	? Unknown Attachment	? Unknown Attachment	Catmull-Clark only
Polygonal Surfaces	? Unknown Attachment	? Unknown Attachment	
NURBS	? Unknown Attachment	? Unknown Attachment	
Curves	? Unknown Attachment	? Unknown Attachment	
Points	? Unknown Attachment	? Unknown Attachment	Falloff is not yet supported

Quadrics and Blobbies	? Unknown Attachment	? Unknown Attachment	
Procedurals	? Unknown Attachment	? Unknown Attachment	
Nested Instancing	? Unknown Attachment	? Unknown Attachment	Only 4 levels of instancing are supported
Nested Dielectrics	? Unknown Attachment	? Unknown Attachment	XPU does not support intersectpriority or nested IOR tracking; refractions may be wrong when leaving an inner nested dielectric material
Dicing cameras	? Unknown Attachment	? Unknown Attachment	

- Loop Subdivision is not supported. Catmull-Clark for both quads and triangles **is** supported.
- Point falloff is not yet supported.
- Shading of nested instancing has artifacts. In our tests we have seen shading issues with leaves that are rendered as nested instances.
- Inverted normals are possible when doing displacement, depending on the input file and DCC. We have seen this with Alembic being imported into Houdini.
- String geometry primvars are not supported.

Lighting

	RIS	XPU	Notes
Analytic Lights	? Unknown Attachment	? Unknown Attachment	PxrEnvDaylight, PxrCylinderLight not available; some light parameters are not available
Mesh Lights	? Unknown Attachment	? Unknown Attachment	
Light Filters	? Unknown Attachment	? Unknown Attachment	
Light Linking	? Unknown Attachment	? Unknown Attachment	
Scalability to many lights	? Unknown Attachment	? Unknown Attachment	Past a certain threshold, XPU's performance will decrease. This will be addressed in a future release.

- XPU does not support manifold next event estimation

Integration & Ray Tracing

	RIS	XPU	Notes
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PxrPath Tracer	? Unknown Attachment	? Unknown Attachment	<ul style="list-style-type: none"> Various supersampling controls are not supported, including: <ul style="list-style-type: none"> sampleMode, and the related manual sampling controls numDiffuseSamples, numSpecularSamples, numSubsurfaceSamples, numRefractionSamples numBxdfSamples numVolumeAggregateSamples numIndirectSamples clampDepth and clampLuminance (used to suppress fireflies) has not been implemented. Non-stochastic presence is not currently supported - the maxNonStochasticOpacityEvents parameter is ignored. XPU's implementation of Russian Roulette differs from RIS
PxrUnifed	? Unknown Attachment	? Unknown Attachment	
PxrVisualizer	? Unknown Attachment	? Unknown Attachment	<ul style="list-style-type: none"> shadedPrimVar is not supported matCap is not supported
PxrDefault	? Unknown Attachment	? Unknown Attachment	
Trace Sets	? Unknown Attachment	? Unknown Attachment	

Post Processing

	RIS	XPU	Notes
Denoising	? Unknown Attachment	? Unknown Attachment	
Sample and Display Filters	? Unknown Attachment	? Unknown Attachment	

Pipeline

	RIS	XPU	Notes
AOVs and LPEs	? Unknown Attachment	? Unknown Attachment	
EXR, TIFF	? Unknown Attachment	? Unknown Attachment	
Deep Output	? Unknown Attachment	? Unknown Attachment	
Holdouts	? Unknown Attachment	? Unknown Attachment	
Advanced DOF controls (bokeh, etc)	? Unknown Attachment	? Unknown Attachment	

Checkpointing	? Unknown Attachment	? Unknown Attachment	
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- XPU currently only outputs EXR or TIFF frames.
- Only some geometric built-in AOVs are available under the same name as they are available for RIS.
- Multi-camera, multi-frame is not yet supported.
- The "weighted" option for the pixelfiltermode parameter to the Hider will not be supported.
- Baking - either at the pattern level via PxrBakeTexture or at the renderer level to bake global illumination - is not yet supported.
- Cached presence or opacity is not supported in XPU. XPU renders of transparent surfaces may be sharper as a result (they will not be biased by the micropolygon size).

Projection Plugins

	RIS	XPU	Notes
PxrPerspective	? Unknown Attachment	? Unknown Attachment	
PxrOrthographic	? Unknown Attachment	? Unknown Attachment	
PxrCamera	? Unknown Attachment	? Unknown Attachment	Matte, shutter direction/sweep and Circle of confusion texture not yet supported in XPU
PxrLightProbe	? Unknown Attachment	? Unknown Attachment	
PxrPanini	? Unknown Attachment	? Unknown Attachment	
Omnidirectional Stereo	? Unknown Attachment	? Unknown Attachment	