AUTODESK. UNIVERSITY

Arnold + USD = Love

Frédéric Servant

Senior Software Development Manager | @fredericservant

About the speaker

Frédéric Servant

Frederic is the Arnold Software Development Manager and is based in London, where he looks over the Arnold core and plugins teams scattered around the globe. He was previously the main developer of the Arnold integration in Houdini. Prior to working on Arnold, Frederic worked as an R&D Engineer at The Mill in London and La Maison in Paris.

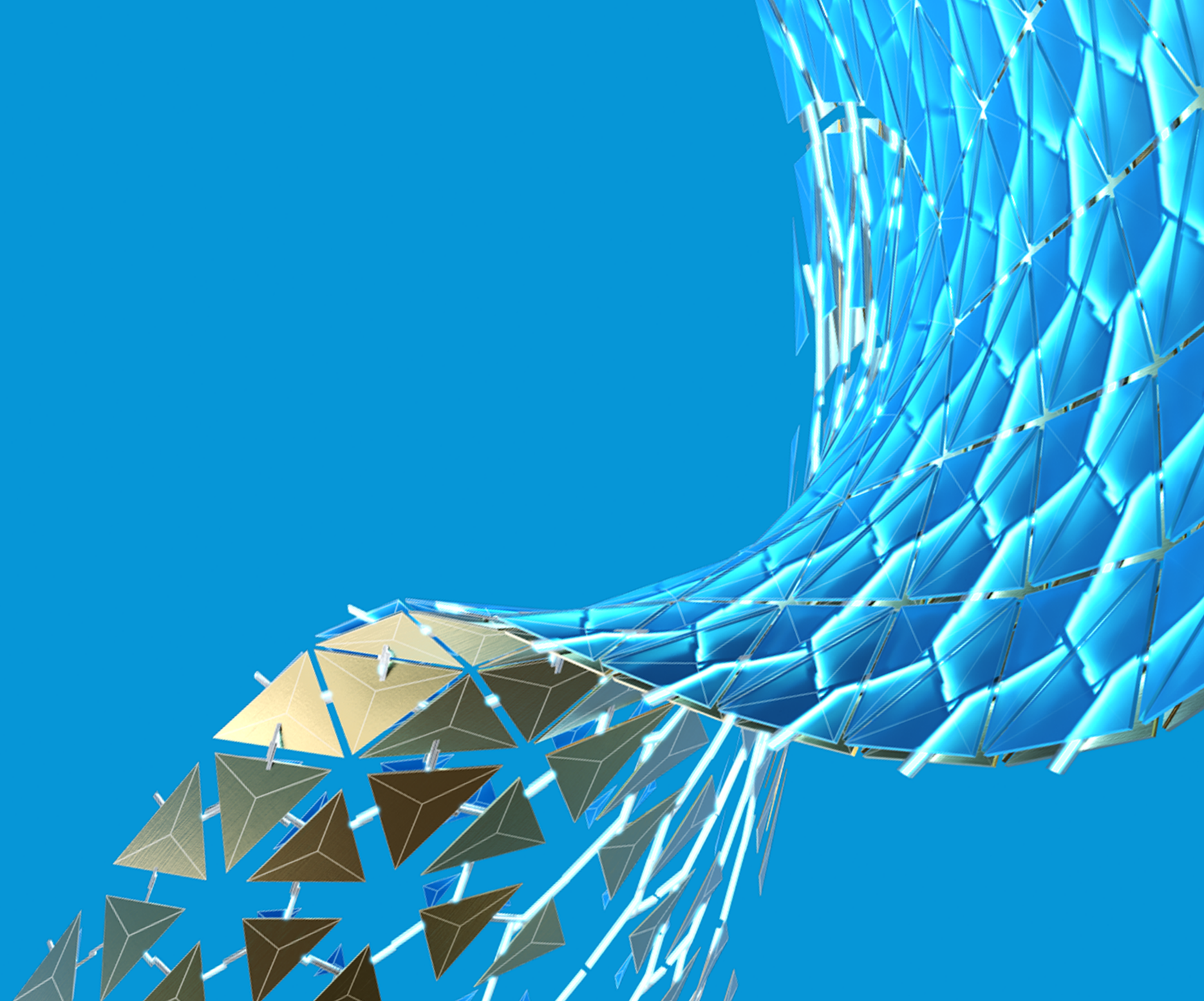
What is Arnold?

- Path tracing in production pioneer
- Scales well for large scenes
- Addresses complex rendering challenges
- Comprehensive C++ and Python API
- Compatible CPU and GPU rendering
- Ships with Maya and 3ds Max
- Plugins for Houdini, Cinema 4D, Katana,...

What is USD?

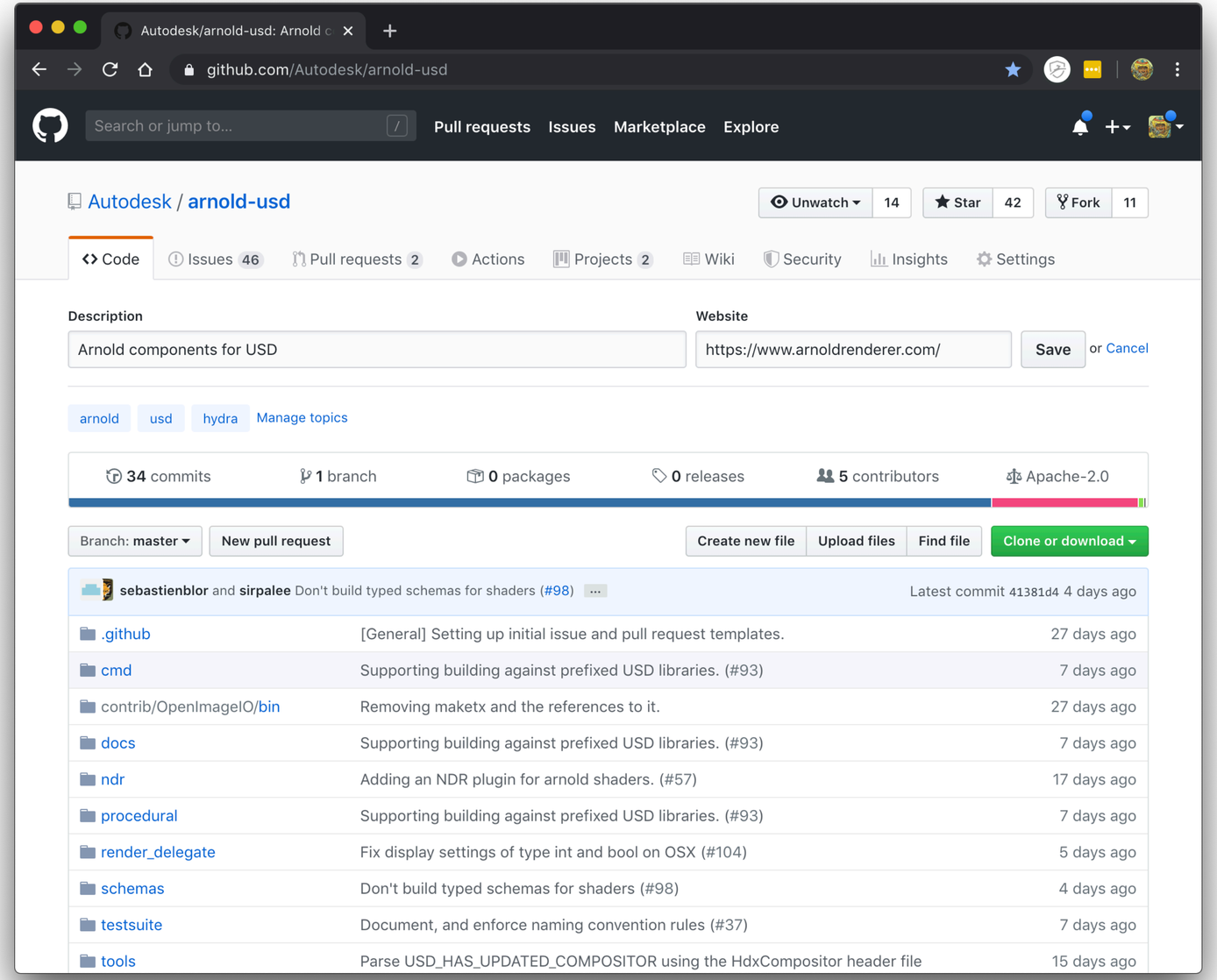
- Framework for interchange of 3D computer graphics data
- File format
- Non-destructive edits
- Variants and opinions
- Created by Pixar

Arnold USD



Arnold USD is open source!
github.com/Autodesk/arnold-usd

- Render delegate
- Procedural
- Schemas
- …



Sprint 31-32

github.com/Autodesk/arnold-usd/projects/21

Search or jump to... / Pull requests Issues Marketplace Explore

Autodesk / arnold-usd

Unwatch 16 | Star 100 | Fork 22

Code | Issues 85 | Pull requests 1 | Actions | Projects 3 | Wiki | Security | Insights | Settings

Sprint 31-32

Updated 12 hours ago

Filter cards | + Add cards | Fullscreen | Menu

5 To do

Crash loading crowd usd file in the arnold procedural
#472 opened by jhodgson
bug procedural

Create UsdImagingDelegate adapters for Arnold Schemas
#185 opened by sirpalee
enhancement schema user

Add CLA
#484 opened by compso
enhancement

Render images using hydra/usdrecord in the testsuite
#27 opened by sirpalee
enhancement render delegate

Nested procedurals ignore matrix in viewport API
#508 opened by sebastienblor
bug procedural

2 In progress

Setup CI for the project
#122 opened by sirpalee
build enhancement investigate

Run the testsuite via CMake
#124 opened by sirpalee
build enhancement

2 Review in progress

HdArnold does not correctly handle texture coordinates when the primvar is not name `st` and `varname` in `PrimvarReader_float2` is of type `string`
#518 opened by arcilat-adsk
bug render delegate

1 linked pull request

render_delegate: Accept both strings and tokens for `varname` on `Pri...
#519 opened by arcilat-adsk
bug render delegate

Changes requested

0 Reviewer approved

7 Done

Per face material assignments
#29 opened by sirpalee
enhancement investigate render delegate user

1 linked pull request

Adding per-face material assignment support to the Render Delegate.
#520 opened by sirpalee
enhancement render delegate user

Changes approved

Support Transform2d for the Render Delegate
#516 opened by sirpalee
enhancement render delegate

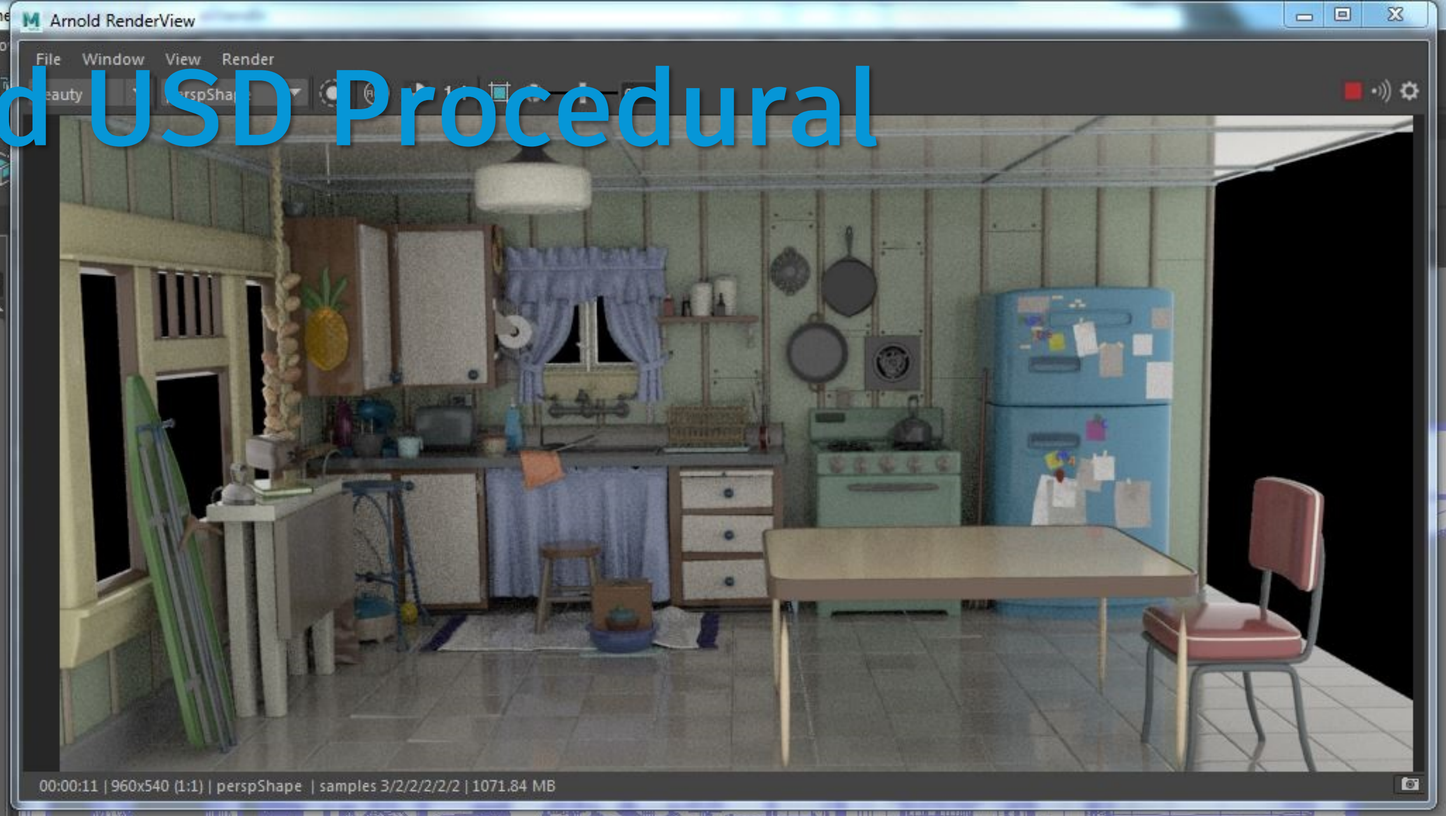
1 linked pull request

Add support for UsdPreviewSurface Usdtransform2d
#515 opened by arcilat-adsk
enhancement render delegate

Changes approved

Viewport representation in points mode doesn't have the correct matrix
#513 opened by sebastienblor
bug procedural

Arnold USD Procedural



Arnold USD Procedural

Shapes

- UsdGeomMesh
- UsdGeomCurves
- UsdGeomPoints
- UsdGeomCube
- UsdGeomSphere
- UsdGeomCone
- UsdGeomCylinder
- UsdGeomPointInstancer
- UsdSkel
- **primvars are translated as Arnold user data**

Arnold USD Procedural
Shaders

- **USD native shaders**
  - UsdPreviewSurface
  - UsdPrimVar*
  - UsdUVTexture

- **Arnold shaders**
  - Supported as UsdShade nodes
  - **info:id** gives the shader type

Arnold USD Procedural

Arnold extensions for nodes & parameters

- Arnold node types:

  ArnoldVolumeImplicit (USD) ↔ **volume_implicit** (Arnold)

- Arnold parameters in USD nodes:

  attribute **arnold:subdiv_iterations** on a UsdGeomMesh

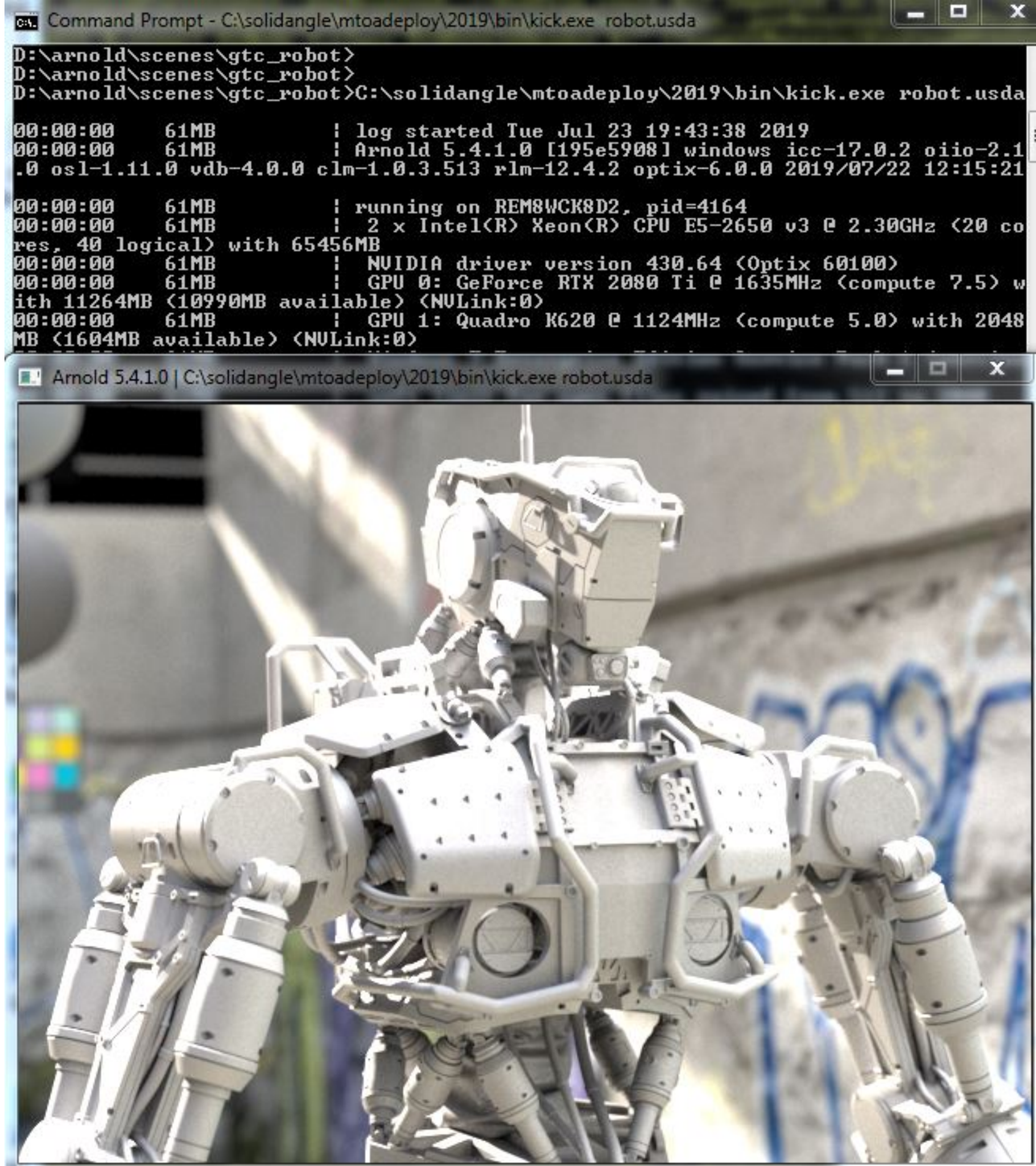
Scene file format API

New in Arnold 6.0.2.0

- AiSceneLoad() / AiSceneWrite()
- USD is a plugin (also Alembic/OBJ/PLY)
- **Export scene as USD from any application…**
- …with Arnold shaders/options/operators…
- Import/Export shader networks

kick .{ass|usd}

- Render USD directly
- ASS-USD 1:1 mapping
- Select frame to render



./kitchenSet/Kitchen_set.usd
File Edit View Window
Arnold Hydra Delegate
/
Navigation
Prim Name
Type
Vis
root
Kitchen_set Xform V
Arch_grp Xform V
Kitchen_1 Xform V
Props_grp Xform V
North_grp Xform V
West_grp Xform V
DiningTable_grp Xform V
Ceiling_grp Xform V
Hydra: Arnold
Search for prim by name
Find Prim
Render: 17.43 ms (57.38 FPS)
Playback: N/A
Camera: Free
Complexity: Low
Type
Property Name
Value
World Bounding Box [(-221.34317016601562, -252.31224060058594, -7.122506079...363.558837890625, 196.9837188720703, 317.9218758674561)]
Local to World Xform ((1, 0, 0, 0), (0, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1))
Resolved Preview Material <unbound>
Resolved Full Material <unbound>
Search for property by name
Find Prop
Value
Meta Data
Layer Stack
Composition
0.0
0.0
Play
Redraw On Frame Scrub
Step Size 1.0
Frame: 0.0

/home/herubea/HoudiniProjects/hydra/sophie_v4.hip - Houdini FX 18.0.274

Houdini Solaris

File Edit Render Assets Windows Arnold Help | Build | Main

Box Sphere Tube Torus Grid Null Line Circle Curve Draw Curve Path Spray Paint Font Platonic Solids L-System Metaball File

Camera Point Light Spot Light Area Light Geometry Light Volume Light Distant Light Environment Light Sky Light GI Light Caustic Light Portal Light Ambient Light Stereo Camera VR Camera Switcher Gamepad Camera

Scene View | Animation Editor | Render View | Composite View | Motion FX View | Geometry Spreadsheet

stage

Light

Arnold Persp | /render_cam/cam_side_00

Shift-s for specular mode, Shift-d for diffuse mode, Shift-f for shadow mode. Shift-t to toggle look at handle. Press 'b' to toggle resize handle.

rendergeometrysettings1 | Take List | Performance Monitor

stage

Render Geometry Settings rendergeometrysettings1

Primitives `lopinputprims('.', 0)` { usd_istype(0, @primpath, "UsdGe

Karma (Beta) | Arnold

Do Nothing	Transform Type	Linear
Do Nothing		Invert Normals
Set or Create		Smoothing
Set or Create	Subdivision Type	Catmull-Clark
Set or Create	Subdivision Iterations	2
Do Nothing		Subdivision Smooth Derivates
Do Nothing	Subdivision UV Smoo...	Pin Corners
Do Nothing		Subdivision Ignore Frustum
Do Nothing	Subdivision Adaptive...	0
Do Nothing	Subdivision Adaptive...	Auto
Do Nothing	Subdivision Adaptive...	Raster

/stage | Tree View | Material Palette | Asset Browser

stage

Add Edit Go View Tools Layout Help

CONFIDENTIAL H18.0.274 Solaris

camera1
/camera1
2 Layers

Light
arealight1
/lights/arealight1
2 Layers

rendergeometrysettings1
/fin_bag_body_bk_lightMap_Group/fin_bag_body_bk_bag_green_deep... (89)
2 Layers

Camera
adjust_camera
/render_cam/cam_side_01
2 Layers

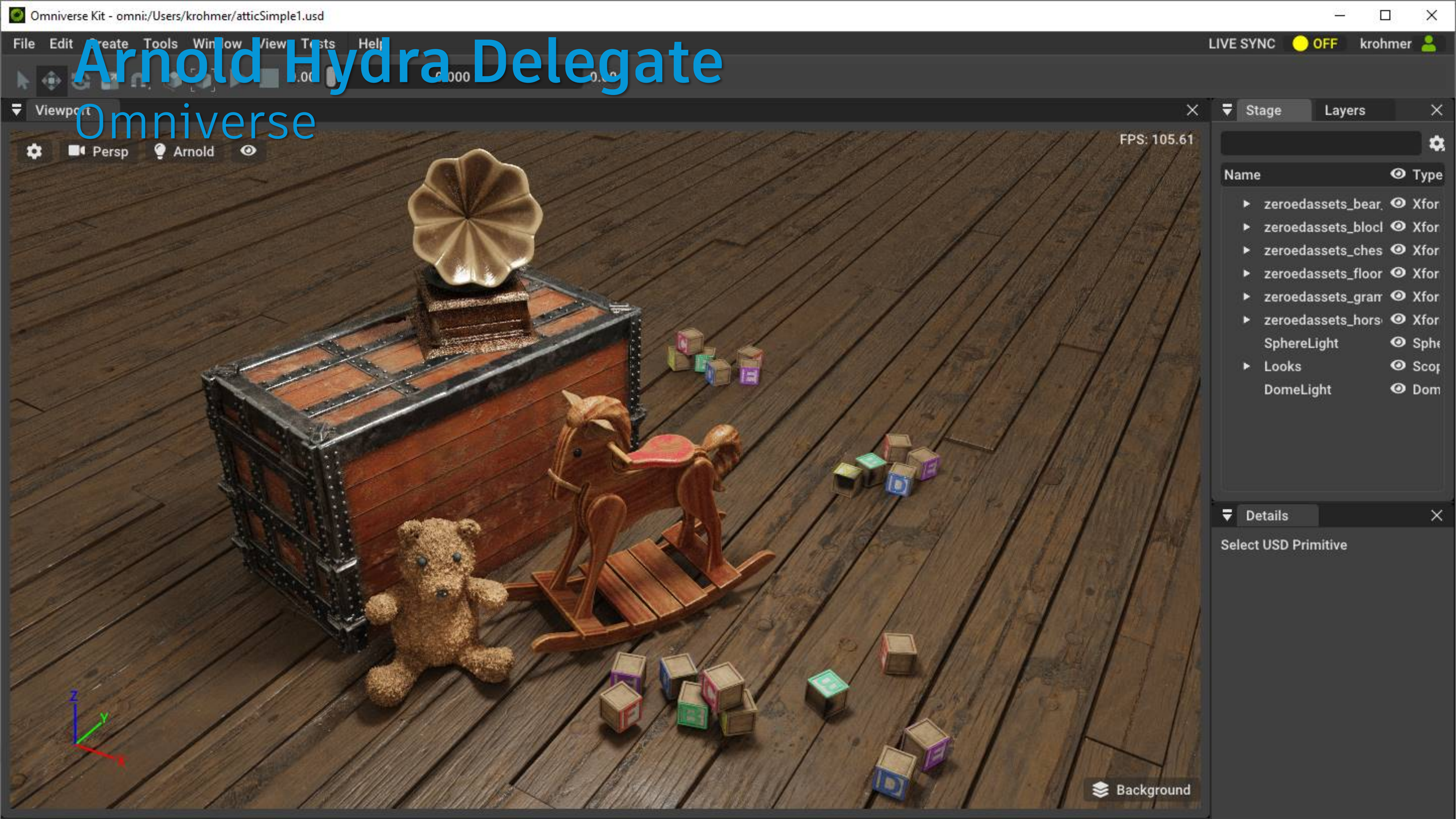
1 24 48 72 96 120 144 168 192 216 2

1 1 240 240

0 keys, 0/0 channels

Key All Channels

Auto Update


Omniverse Kit - omni:/Users/krohmer/atticSimple1.usd
File Edit Create Tools Window View Tests Help
LIVE SYNC OFF krohmer
Arnold Hydra Delegate
Omniverse
Viewport
Persp
Arnold
FPS: 105.61
Stage
Layers
Name
Type
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SphereLight
Looks
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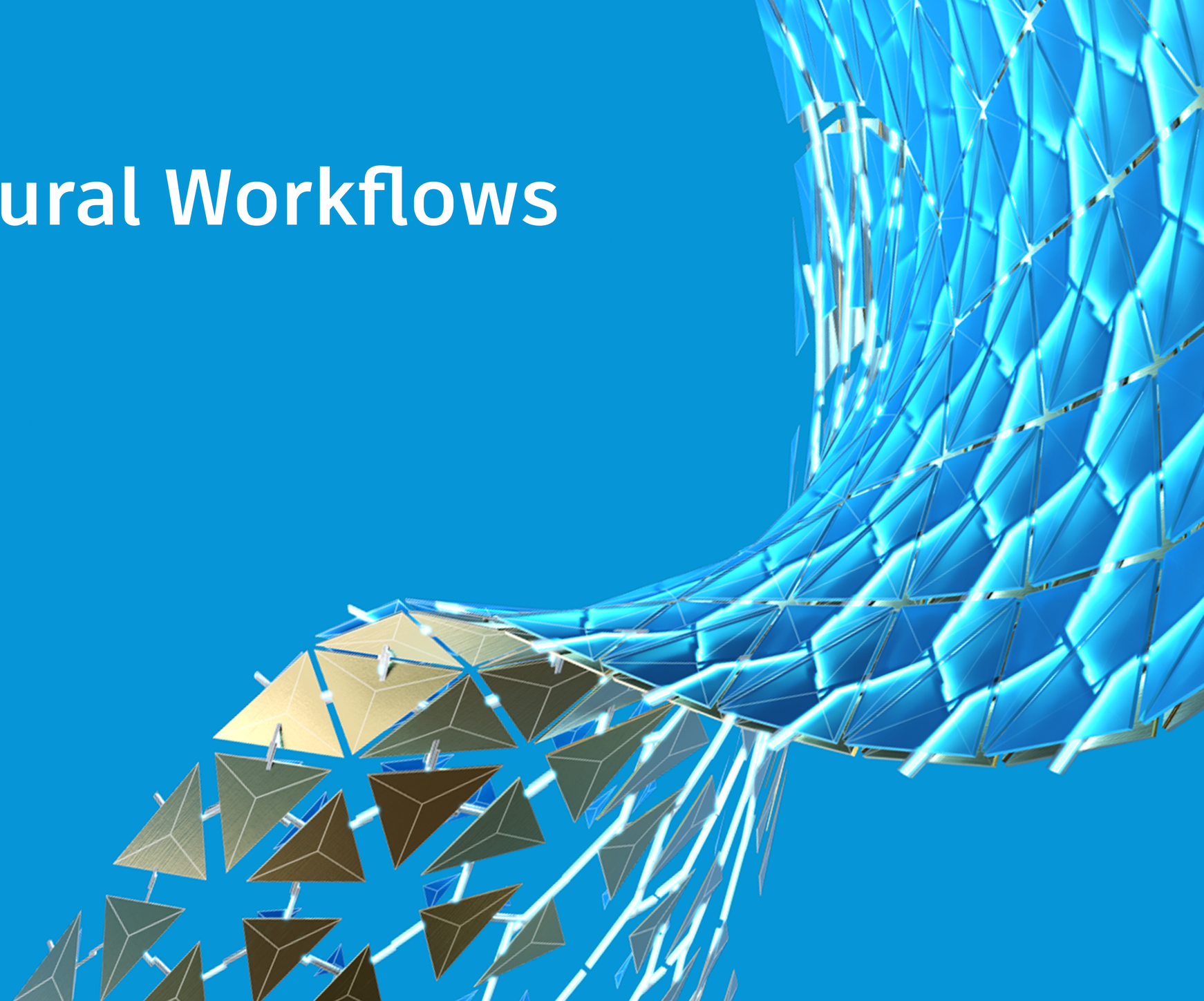
Dom
Details
Select USD Primitive
Background

Arnold Hydra Delegate

Maya USD

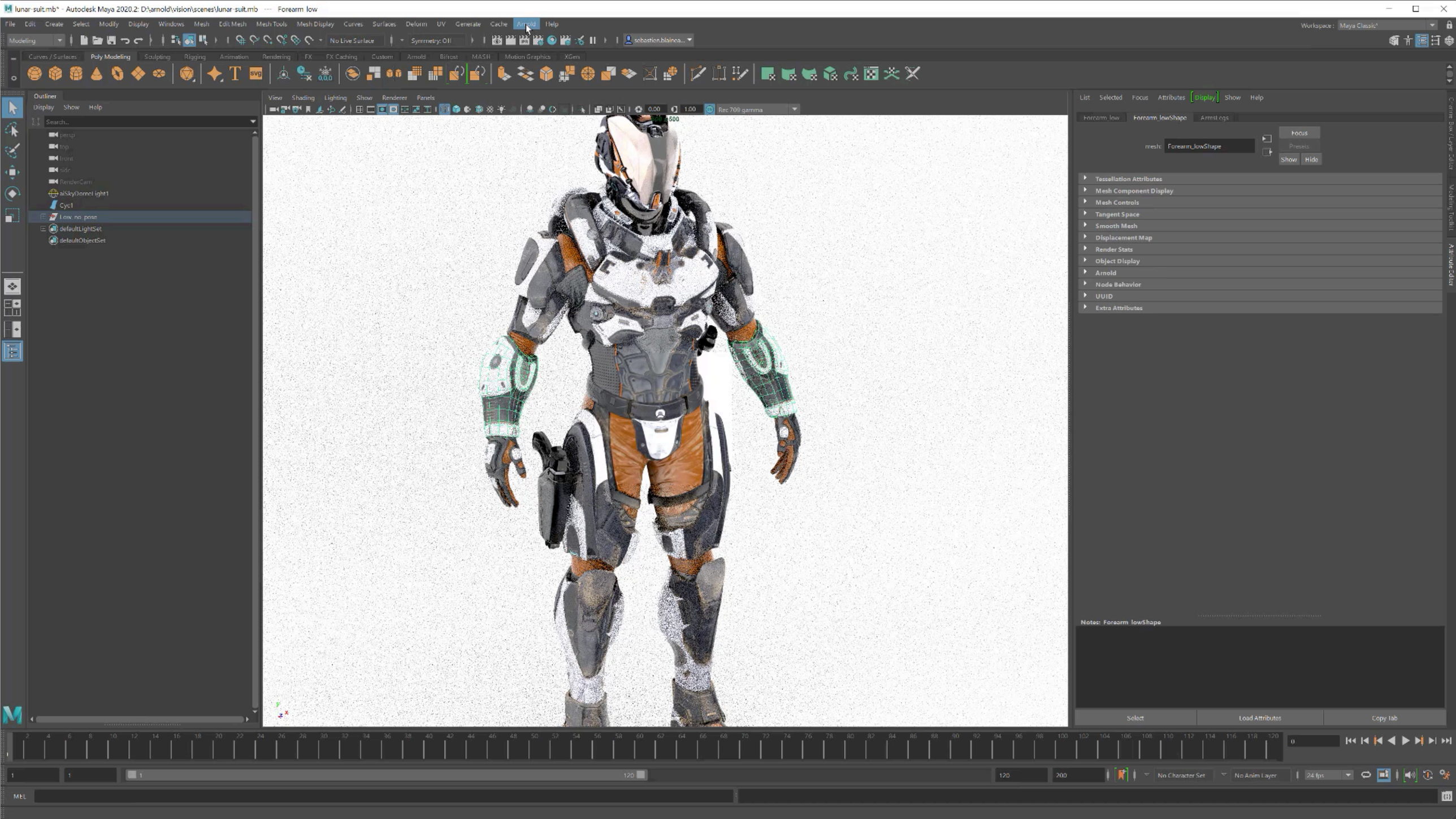
USD Procedural Workflows

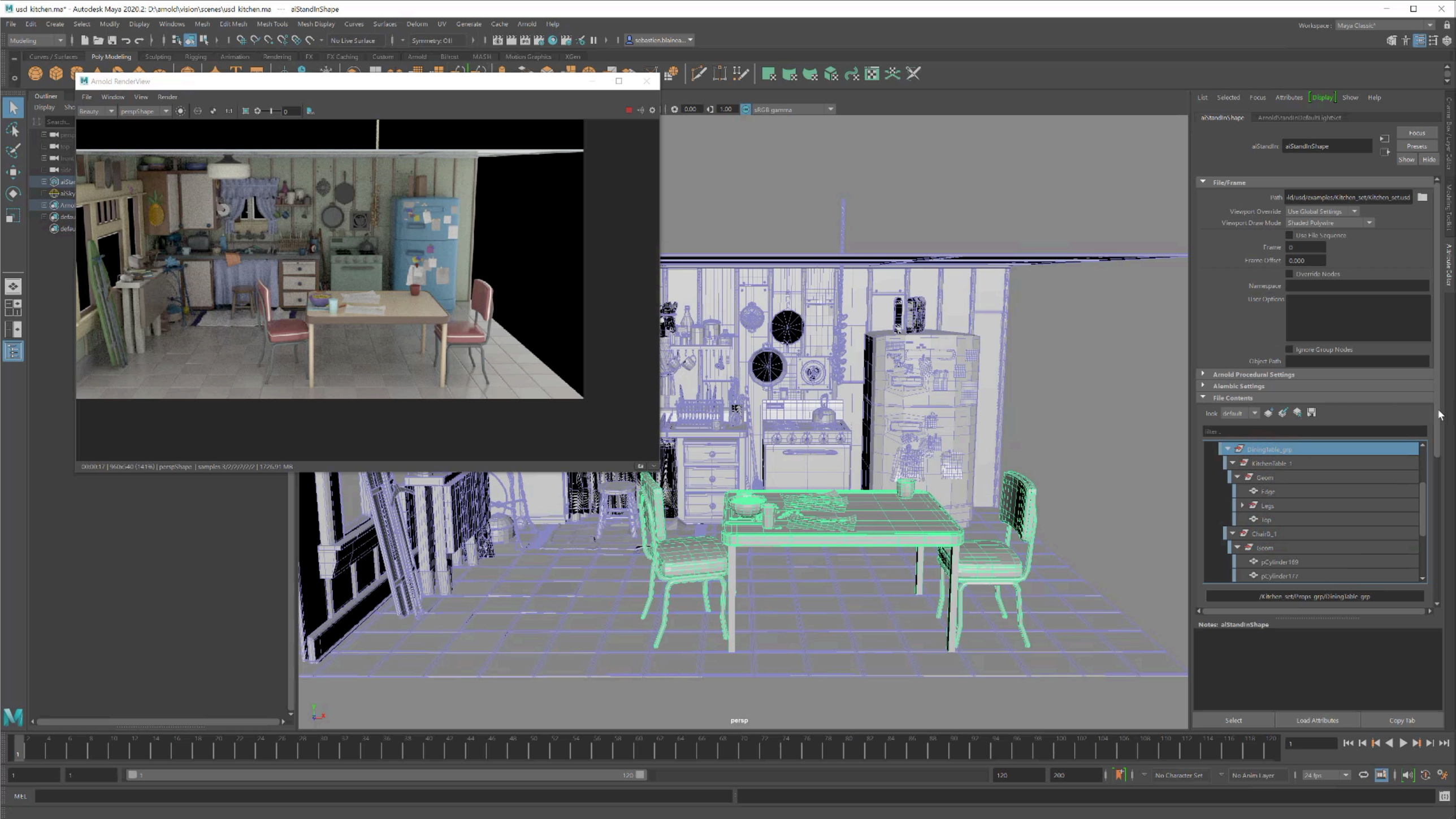


About the speaker

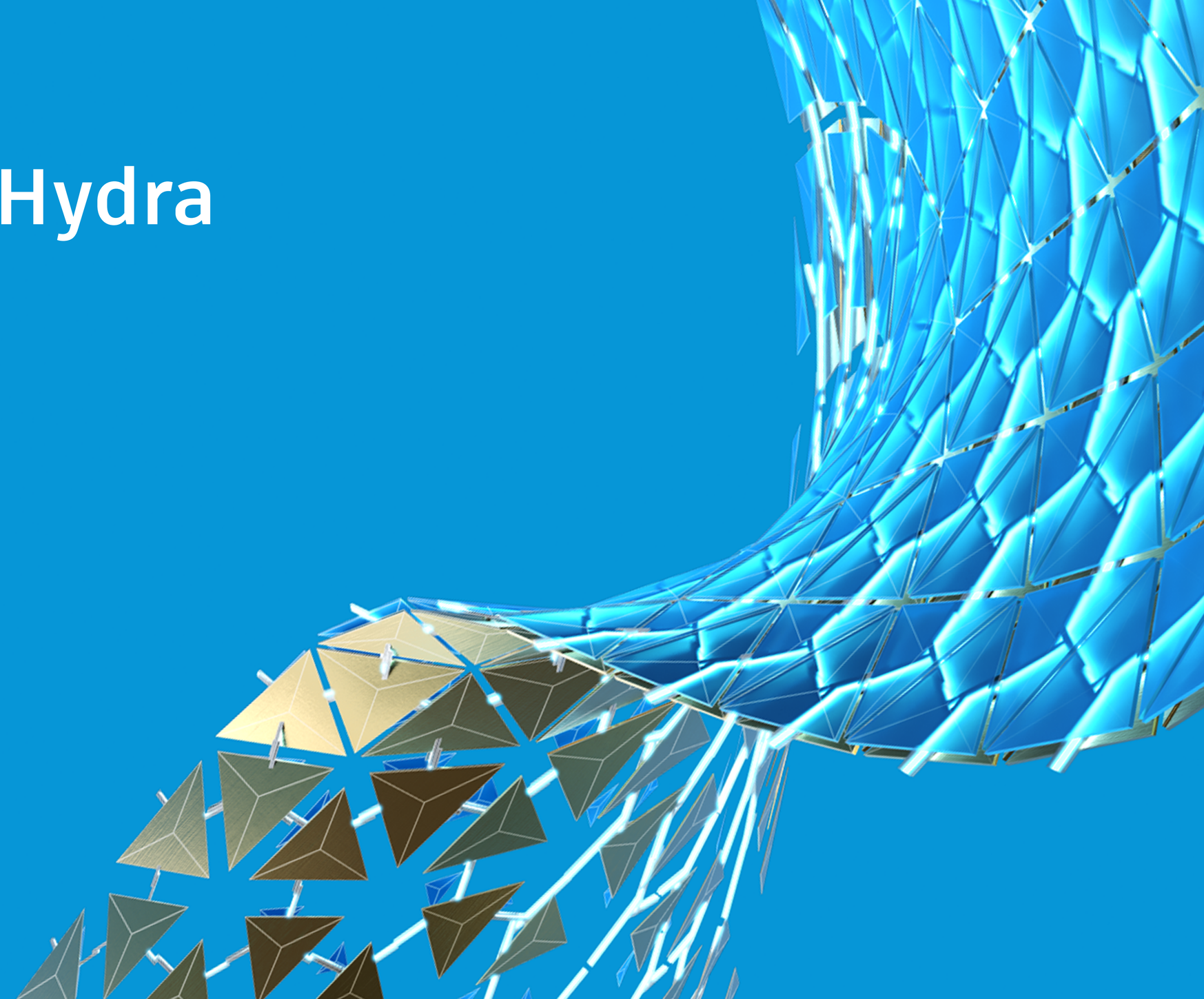
Sébastien Blaineau-Ortega

Sebastien has been working on the Arnold-to-Maya plugin (MtoA) for several years, and on the USD support in Arnold. He developed the Arnold RenderView and works occasionally on Arnold core. He works remotely from a small village near Marseille, France. Prior to joining the Arnold team, he worked at “The Bakery” on a lighting tool called Relight, and in French VFX studios (BUF and Def2Shoot).


lunar-suit.mb* - Autodesk Maya 2020.2: D:\arnold\vision\scenes\lunar-suit.mb --- Forearm low
File Edit Create Select Modify Display Windows Mesh Edit Mesh Mesh Tools Mesh Display Curves Surfaces Deform UV Generate Cache Arnold Help
Workspace : Maya Classic*
Modeling
No Live Surface
Symmetry: Off
Curves / Surfaces Poly Modeling Sculpting Rigging Animation Rendering FX FX Caching Custom Arnold Bifrost MASH Motion Graphics XGen
Outliner
Display Show Help
Search...
persp
top
front
side
RenderCam
aiSkyDomeLight1
Cyc1
Low_no_pose
defaultLightSet
defaultObjectSet
View Shading Lighting Show Renderer Panels
Rec.709 gamma
List Selected Focus Attributes Display Show Help
Forearm_low
Forearm_lowShape
ArmsLegs
mesh: Forearm_lowShape
Focus
Presets
Show
Hide
Tessellation Attributes
Mesh Component Display
Mesh Controls
Tangent Space
Smooth Mesh
Displacement Map
Render Stats
Object Display
Arnold
Node Behavior
UUID
Extra Attributes
Notes: Forearm_lowShape
Select
Load Attributes
Copy Tab
No Character Set
No Anim Layer
24 fps
MEL


usd kitchen.ma* - Autodesk Maya 2020.2: D:\arnold\vision\scenes\usd kitchen.ma --- aiStandInShape
Arnold RenderView
persp

Arnold and Hydra



About the speaker

Pal Mezei

Pal is a software engineer with more than 12 years of professional experience, in animation, visual effects and software development. He started his career working on commercials and trailers for games like Mass Effect and Assassin's Creed. He first joined the Arnold team in 2012 for 3 years before heading to the land of roos to work on Marvel movies like Antman, Avengers or Doctor Strange. In his free time, he likes playing games, writing silly stuff, climbing the ivory tower and dreaming about the future where programming is memory safe, high performance and functional.

Universal Scene Description

Base

Utilities: Math, OS,
Dynamic libraries,
Multithreading …

USD

File formats,
primitives, built-in
schemas, skeleton,
shaders …

Imaging (Hydra)

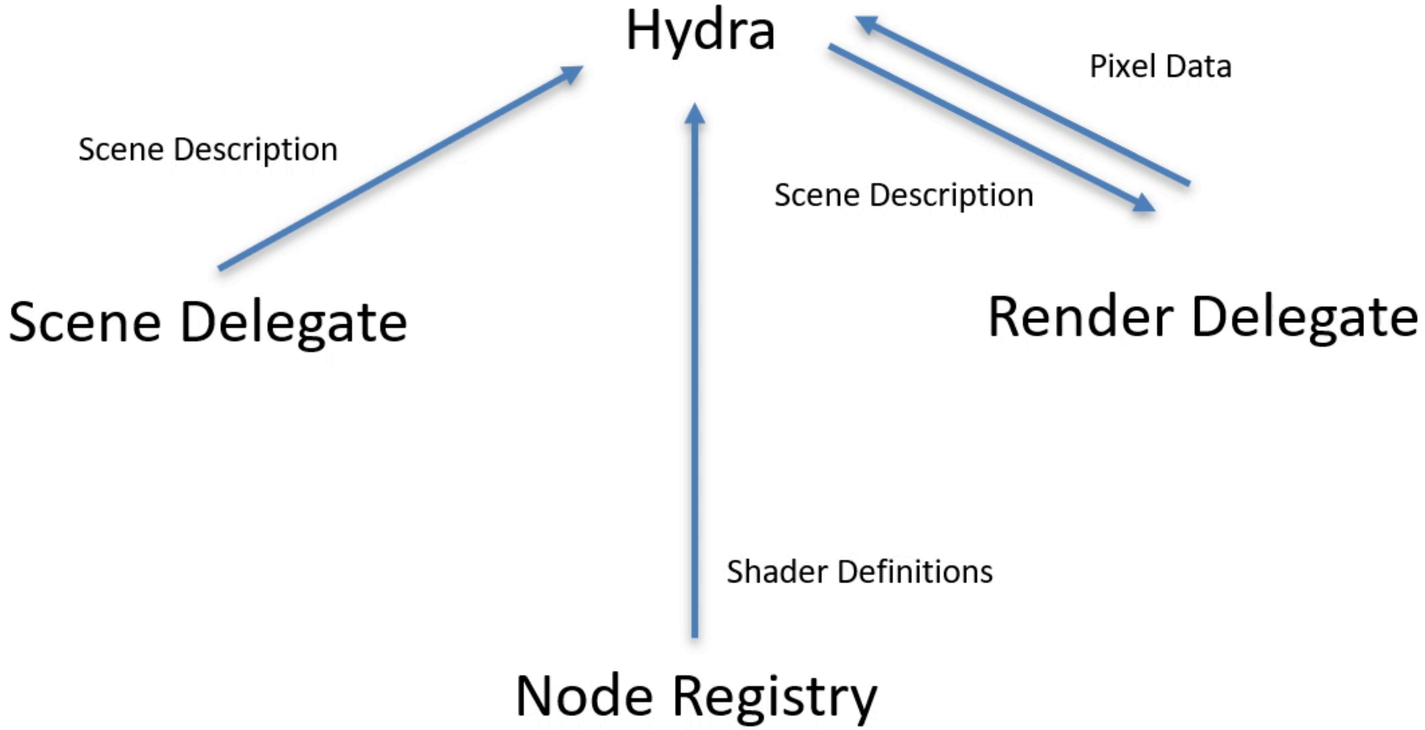
Rendering, GPU interop,
OpenGL tools, Metal …

UsdImaging

Hydra Scene Delegate,
OpenGL Shaders,
UsdView, UsdRecord …

… and many more.

Hydra High-Level Overview



C:/scenes/Vision2020/scene.hip - Houdini FX 18.0.532

File Edit Render Assets Windows Arnold Help | Solaris | Main

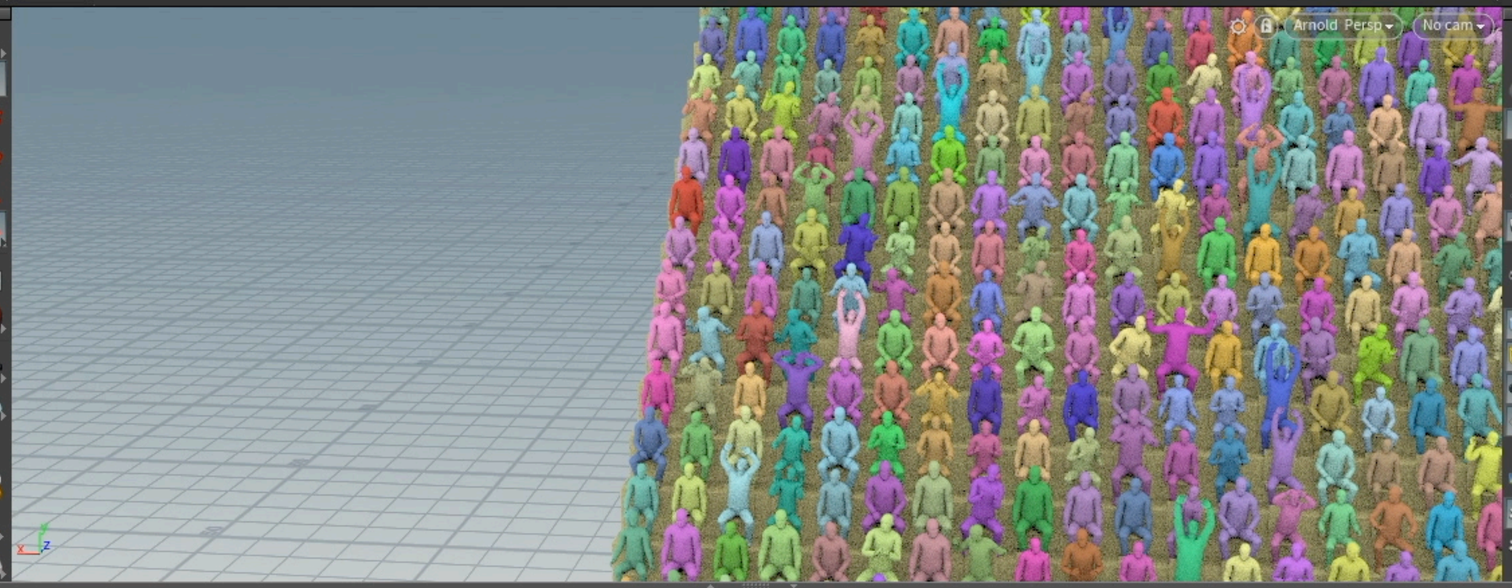
LOP Lights and Cameras: Camera, Point Light, Spot Light, Area Light, Geometry Light, Volume Light, Distant Light, Environment Light

Test Geometry: Test Geometry: C..., Test Geometry: P..., Test Geometry: R..., Test Geometry: S..., Test Geometry: S..., Test Geometry: T...

Scene View | Animation Editor | Geometry Spreadsheet

stage

Render Var



diffuse | Context Options Editor | Performance Monitor

stage

Render Var diffuse

Primitive Path /Render/Products/Vars/$OS

Action Create

Create Primitives

Standard | Arnold | Karma (Beta)

Set or Create	Data Type	color3f
Set or Create	Source Name	specular_direct
Set or Create	Source Type	Raw
Set or Create	Name	$OS
Set or Create	Format	float
Set or Create		Multi Sampled
Set or Create	Clear Value	0

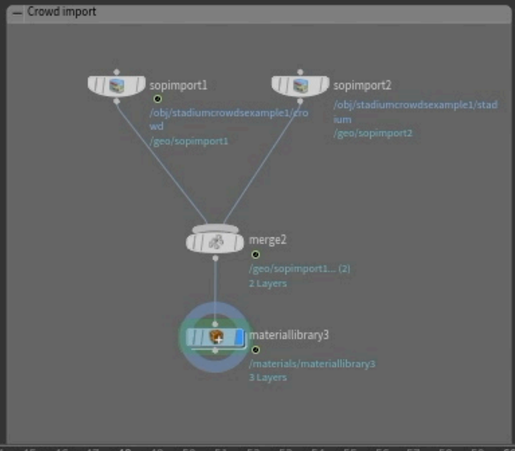
/stage | Material Palette

stage

Add Edit Go View Tools Layout Help

Solaris

Crowd import



Scene Graph Tree | Scene Graph Details | Scene Graph Layers Panel

stage

Showing: Composed scene graph

Scene Graph Path	Primitive Type	Variants	Kind	Draw Mode	P	L	A	V	S
Top_lowShape	Mesh								
Pistol_Pouches									
Visor									
Scarf_low									
Scarf_lowShape	Mesh								
Visor_low									
Visor_lowShape	Mesh								
Render	Scope								
Products	Scope								
Vars	Scope								
color	RenderVar								
diffuse	RenderVar								

Name	Value
/Render/Pr...	
dataType	color3f
driver:...	0
driver:...	float
driver:...	False
driver:...	diffuse
source...	specular_direct
source...	raw

Value | Metadata | Layer Stack

Filter:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

30 | 1 | 1 | 60 | 60

0 keys, 0/0 channels

Key All Channels

Spacebar for viewing and unrestricted scrubbing. Middle mouse drag on frame slider to hold scoped channel values.

/obj/stadiumcr... | Auto Update

What's next?
This is tentative!

- USD Lux upcoming changes
- Custom schemas for procedurals and shaders in Storm/HoudiniGL
- Light linking support
- Plugin architecture for procedural and delegate
- Better Maya/Katana/Max support
- Scenegraph Location Decorator for USD Katana
- Shaders per channel connections
- Native .ass support
- USDZ support
- Arnold nodes & procedural support in Hydra
- Improving documentation
- Moving to CMake
- More tests
- ***Your feature here***

Thank you!

- Luma Pictures
- RodeoFX
- Superprod
- Qvisten Animation
- Megalis
- Skydance
- …
- Pixar
- SideFX
- OTOY
- The Foundry

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