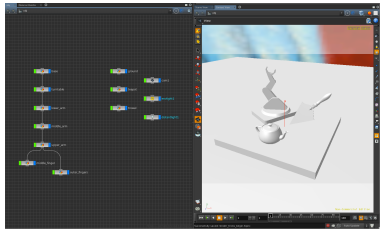
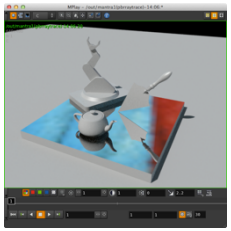
RENDER TRICKS

As everything with 3D is fully controllable, it is possible to make objects and lights behave differently than in the real world. **Open** the scene **render_tricks_begin.hipnc**

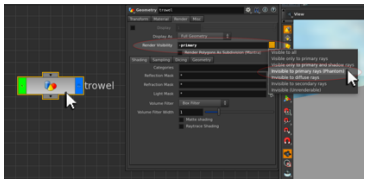


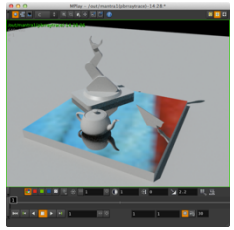


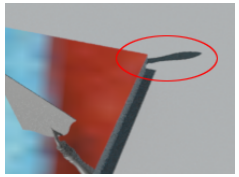
This scene contains some simple objects, and a light and camera setup. When a render is activated, the scene objects are sitting on a mirrored floor tile.

PHANTOM OBJECTS

It is possible to make objects appear only in reflections by activating them as **Phantom Objects**. In the **parameters** for the **trowel_object**, go to the **Render section** and **choose Invisible to Primary Ray (Phantom)** from the **Render Visibility parameter**.



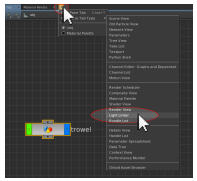


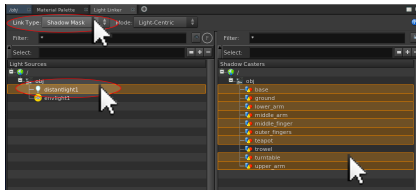


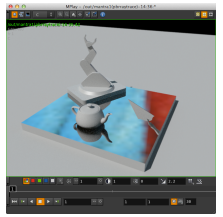
When the scene is rendered again, the trowel appears in the floor reflection but is missing from the main render. Examination of the render reveals that the shadow of the trowel object is however still casting into the scene.

LIGHT, SHADOW AND REFLECTION LINKING

It is possible to set lights, shadows and reflections to cast only for specific objects. This can be done using the **Light Linker**. Over the **Network Editor**, activate a **Light Linker** as a **New Pane Tab Type**.

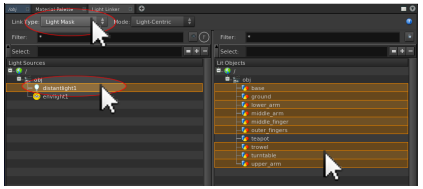


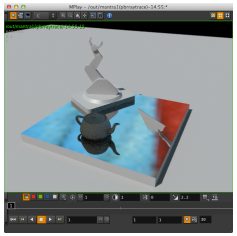




In the **Light Linker** pane, set the **Link Type** to **Shadow Mask**, and from the **Light Sources list select distantlight1**. Using **CTRL** + **LMB** to **deselect** the **trowel** from the **Shadow Casters** list. When the scene is rendered again, the erroneous trowel shadow has disappeared from the render.

Return to the **Light Linker**, and set the **Link Type** to **Light Mask**. From the **Light Sources list select distantlight1**. Using **CTRL + LMB** to **deactivate** the **teapot** from the **Lit Objects list**.

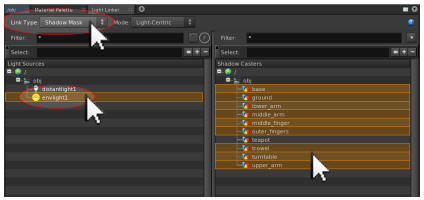


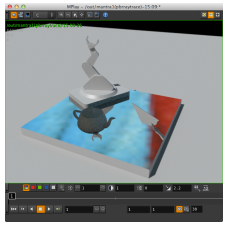


When the scene is rendered again, the teapot now only receives light from the environment light.

Return to the **Light Linker**, and set the **Link Type** to **Reflection Mask**. From the **Reflection Objects list select** the **teapot**. Using **CTRL + LMB** deactivate the ground object in the **Reflector Objects list**.

Next activate the **Link Type** to a **Shadow Mask**, and from the **Light Sources** list select **environmentlight1**. Using **CTRL + LMB** deactivate the teapot in the **Shadow Casters list**.

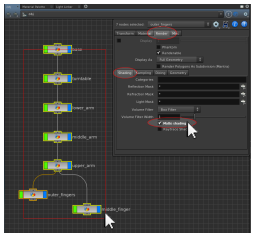


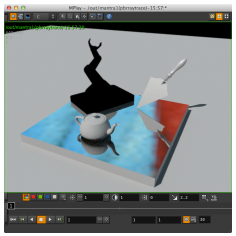


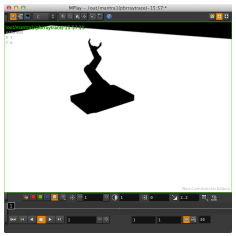
When the scene is rendered again, the teapot no longer appears in the floor reflections.

MATTE OBJECTS

Scene objects can also be set as **Matte Objects**. These type of objects cut out object shaped holes in both the Colour and Alpha channels. **Select** all of the **objects** that create the **Robot Arm**, and in their **combined parameters activate** the **Render** > **Shading** > **Matte shading tick box**.





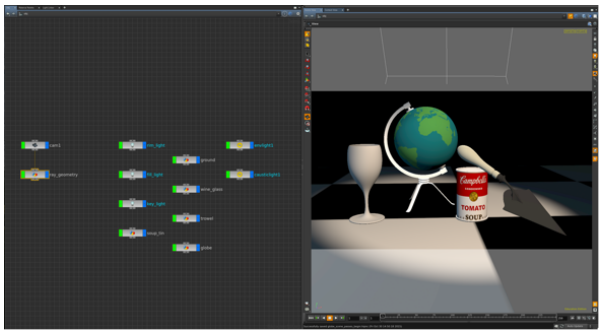


When the scene is rendered again, the robot arm is removed from both the colour and alpha channels.

See file render_tricks_end.hipnc

CUSTOM RENDER PASSES

Open the scene **globe_scene_passes_begin.hipnc**. This is the **final scene file** from the **Texturing and Render Passes lecture**, with the addition of a **ray_geometry object parented to the camera** to help calculate a lit fog render pass that will be created as part of this example.



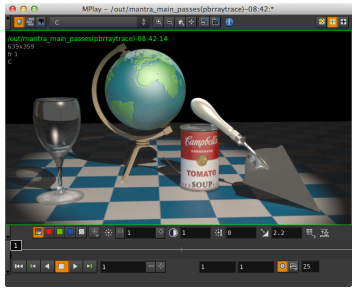
At **Outputs Level** a **Mantra ROP** has been configured to output the **C (Beauty) render** and the following **Image Planes**:

Pz (Depth)
Indirect Shadows (PBR Ambient Occlusion)
Direct Shadows
Indirect Diffuse (bounce light)
Indirect Reflect (reflections)
Indirect Refract (refractions)
Caustics
Direct Diffuse (colour + direct lighting and shadows)
Direct Reflect (specular highlights)
Direct Refract (empty)

This example will examine how render time can be reduced before render optimisation takes place, and how to create custom render passes using a system in Houdini called Takes.

IMPROVING RENDER TIME FROM THE ENVIRONMENT LIGHT

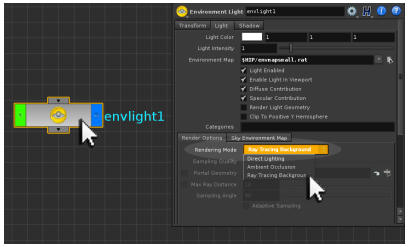
Even before formally optimising a scene for rendering, it is a good idea to get the scene rendering as fast as possible. This is an iterative process of reassessing the scene's configuration and seeing where improvements can be made. Any improvements will be then further enhanced when formal optimising of the scene for rendering occurs.



Switch to **Outputs Level** and **render** the **mantra_main_passes_exr** node to **MPlay**. This will render a one-third resolution of the scene. Examination of the render as it appears reveals there is a **slowing down of render time** when the **wine_glass object** is **rendered**. This is due to the standard settings of the Environment Light creating the refractions of the Environment Map in the wine_glass object.

Leaving **MPlay** open, switch to the **Objects Level** of Houdini and locate the **Environment Light**. In its **parameters** specify:

Rendering Mode **Ray Tracing Background**

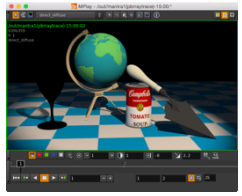
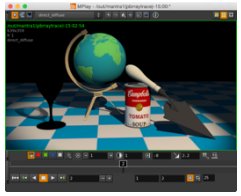


This is an alternate calculation for the Environment Light that can help improve render times. When the **scene** is **rendered to MPlay** once more, the **overall time** of the **image rendering** is **faster** than the time of the render when Direct Lighting was specified.

Comparison of the two renders reveals an overall slight lighting difference to the overall look of the render. Given however the significant improvement in rendering time, this difference becomes negligible and could be countered by a slight modification to the scene lighting if necessary.

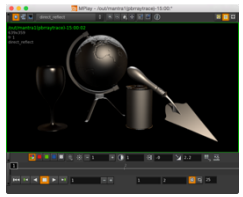
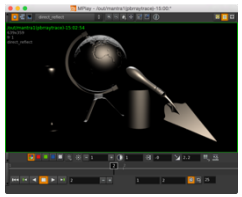
Examination of the **Image Planes** reveals some differences. While most image planes are identical, **the following image planes have changed**:

Direct Diffuse **Direct Lighting** **Ray Tracing Background**

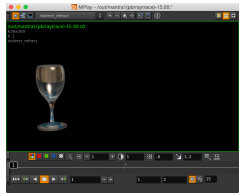
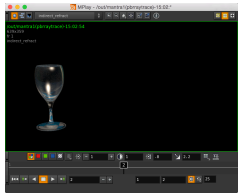
The **Direct Diffuse Image Plane** is **missing** the **ambient Environment Lighting** of the scene, creating slightly **darker shading** on the **globe**, **trowel** and **soup_tin objects**.

Direct Reflect **Direct Lighting** **Ray Tracing Background**

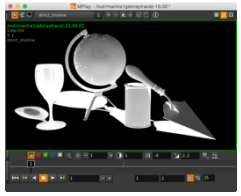
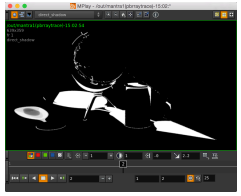
The **Direct Reflect Image Plane** is **missing** the **ambient Environment Lighting** of the scene, creating slightly **darker shading** on all scene objects.

Indirect Refraction **Direct Lighting** **Ray Tracing Background**

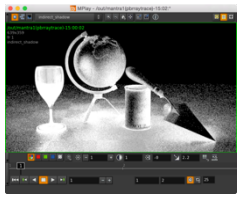
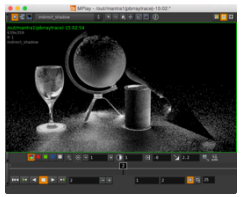
The **Indirect Refractions Image plane** is **missing** the **room environment** from the **refraction information** of the **glass**.

Direct Shadow **Direct Lighting** **Ray Tracing Background**

The **Direct Shadow Image Plane** with **Ray Tracing Background** is however now **correct for compositing**. **Modification** of the **Direct Shadow Image Plane settings** is therefore **required** to remove the **Environment Light** from the **Direct Lighting render**.

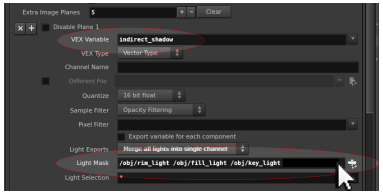
Indirect Shadow **Direct Lighting** **Ray Tracing Background**

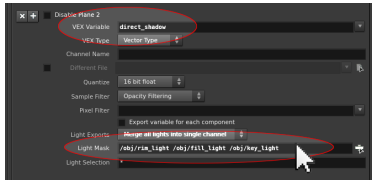
Similarly, the **Indirect Shadow Image Plane** with **Ray Tracing Background** is now also **correct for compositing**. **Modification** of the **Indirect Shadow Image Plane settings** is therefore **required** to remove the **Environment Light** from the **Direct Lighting render**.

FIXING THE SHADOW PASSES

In the **settings** for the **Indirect Shadow Image Plane**, **remove** the reference to **/obj/envlight1** from the **Light Mask parameter**.



Repeat this step for the **Direct Shadow Image Plane**, removing reference to **/obj/envlight1** from the **Light Mask parameter**.



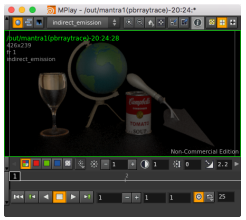
RETRIEVING THE MISSING ENVIRONMENT LIGHT INFORMATION

While the disappearance of the Environment Light information may initially appear confounding, exploration of other currently inactive image plane outputs reveal that this information is now simply being stored elsewhere. The saving in render time is therefore a worthwhile event; however an additional Image Plane needs activating in order to restore this Environment Light information for the composite.

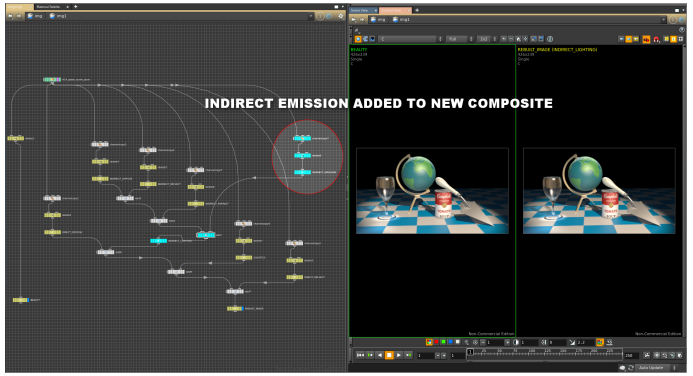
Using the **Extra Image Planes section** of the **Mantra ROP**, activate a **new Image Plane** with the following settings:

VEX Variable **indirect_emission**

When the scene is rendered to MPlay again, the **Indirect Emission** image plane now holds the missing lighting information for the scene.



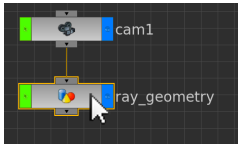
A **full resolution render** of the scene can be generated to **prove all of the image planes re-combine** successfully in the composite. A **full resolution render** also reveals that the **saving in render time** at the low resolution is also **applicable** to the **render time** of the **full resolution image**. When determining the different image planes for rendering, a **Still Frame Composite** is useful for verifying that the render passes are all working as expected.



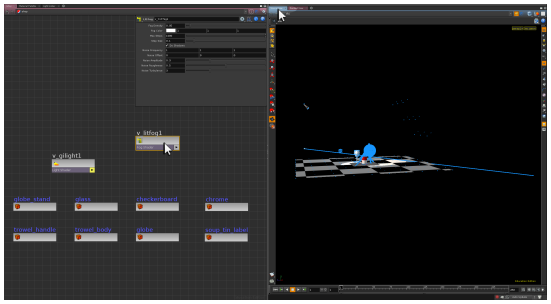
See file globe_scene_passes_stage1.hipnc

CREATING A CUSTOM LIT FOG TAKE

Sometimes when creating atmospheric effects, it can be better to **isolate the atmospherics** in a **custom render pass**. This can be done using a mechanism in Houdini called **Takes**. In **preparation** for creating a **lit fog effect**, a **pre-configured ray geometry object** has already been added to the scene.

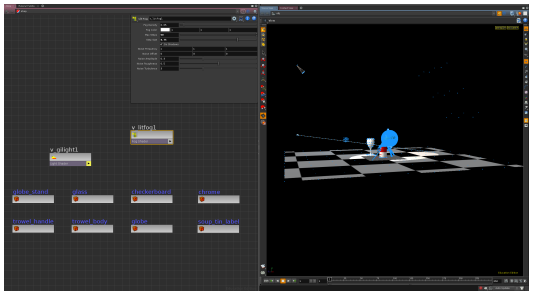


Head to **SHOP Level**, and create a **Lit Fog Shader**. When a **Scene View** is activated, and the view tumbled to see a side view of the scene, the **ray_geometry** reveals an **inefficient Lit Fog setup**, as the line generated extends much further than the spotlight region.

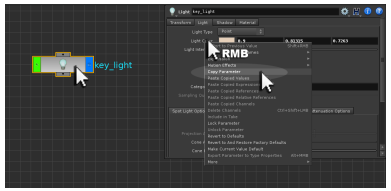


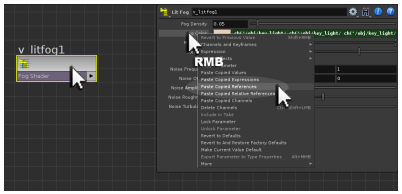
NOTE: As the **ray_geometry object** has been **channel referenced** to look for a node called **v_litfog1** at **SHOP Level**, it will automatically find this newly created Lit Fog Shader.

In the **Parameters** for the **Lit Fog Shader** set the **Max Steps parameter** to **50**, and the **Step Size parameter** to **0.75**. When the Scene View is examined again, the **ray_geometry line** now extends to the far edge of the spotlight region.



As the **Lit Fog** will be **generated** for the **Key Light** of the globe scene, it is important to make the **colour** of the **fog** match the **colour** of the **Key Light**. At **OBJ Level**, **RMB** on the **Light Color Parameter** of the **key_light object**, and choose **Copy Parameter** from the resulting menu.





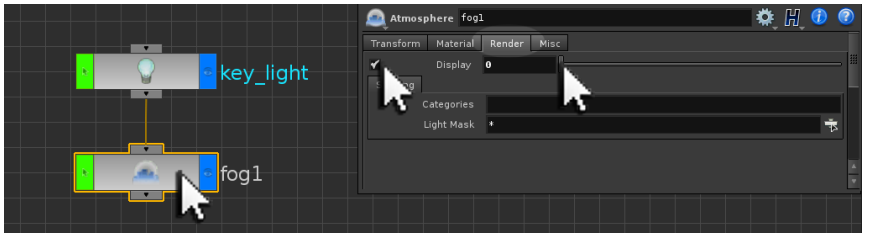
Back at **SHOP Level**, **RMB** on the **Fog Color** parameter of the **v_litfog1 node**, and choose **Paste Copied References** from the resulting menu.

CONFIGURING THE LIT FOG OBJECT

At **OBJ Level**, append an **Atmosphere Object** to the **key_light**. In the **Render Parameters** for the Atmosphere Object specify:

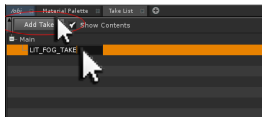
☑ **Display** **0**

This will ensure that the **Atmosphere Object** does **not interfere** with the **main scene setup**.



CONFIGURING THE LIT FOG TAKE

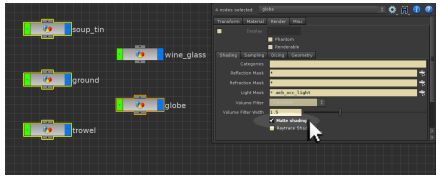
Over the **Network Editor**, activate a **Take List** as a **New Pane Tab Type**. Select **the Main Take** and press the **Add Take** button to create a new Take derived from the main scene setup. Rename this new Take to **LIT_FOG_TAKE**, make sure it is **selected** and then activate **Auto Takes**.



NOTE: On Apple computers, the Auto Takes option resides under the **Takes Menu**.

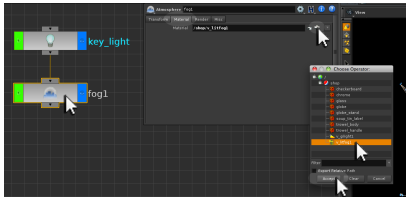
The **LIT_FOG_TAKE** is a **duplicate layer** of the **original scene** (**the Main Take**); however this layer **can be modified further** from the Main Take creating a **bespoke output** for the scene, whilst **leaving the original setup untouched**. The **Auto Takes option** means that with the **LIT_FOG_TAKE activated**, any **changes** to the **scene parameters** in this Take will be stored as an override to the main scene configuation.

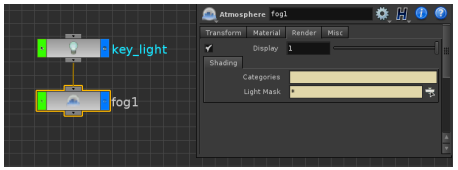
Back in the **Network Editor**, **select all** of the **Geometry Objects apart from** the **wine_glass** and activate the **Matte Shading** option from the **Render > Shading** section of the **parameters**. This option will override the texture information for each object causing them to render as empty black objects.



NOTE: As the **Lit Fog** will still need to **refract through** the **wine_glass**, a different configuration needs to be assigned to this object.

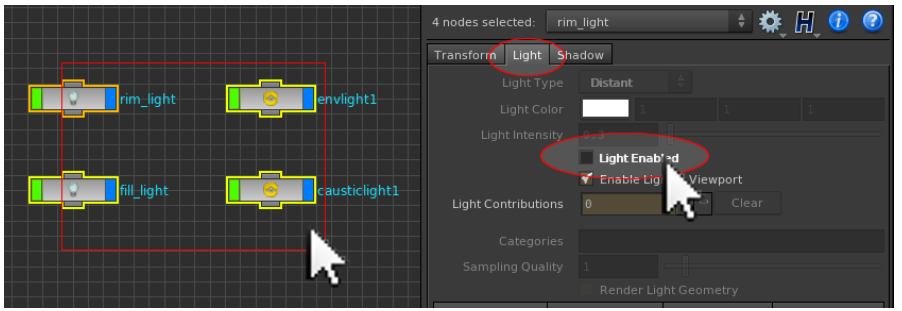
Select the key_light's **Atmosphere Object**, and under the **Material** section of its **Parameters**, specify the **Material** as **/shop/v_litfog1**. This will activate Lit Fog on the key light within the context of the LIT_FOG_TAKE.





Under the **Render section** of the **parameters** set the **Display parameter** to **1**. This will **activate** the **Atmosphere object** in the **render**.

In order to ensure the **Lit Fog** is only calculated for the **key_light**, **all other scene l**ights must be **deactivated**.



In the **Network Editor**, select **all of the lights apart from the key_light** and **deactivate** the **Light Enabled option** from the **Light section** of their **combined parameters**.

CONFIGURING THE WINE GLASS

Head to **SHOP Level**, and locate the **glass material**. Ensure that the **LIT_FOG_TAKE** is **active** and the **Auto Takes** option **enabled**. In the **Parameters** for the **glass material** specify:

Reflect > Reflect Lights

Specular Intensity **0**

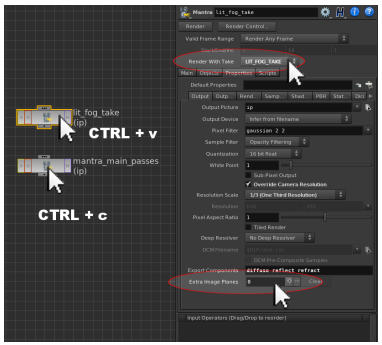
Reflect > Reflect Objects

Reflect Objects

This will **deactivate** all of the **glass material's properties apart** from its **refractive components**. The **LIT_FOG_TAKE** is **now configured** and ready to render.

CREATING A LIT FOG MANTRA

Head to **OUT Level** and **reset** the **Takes System** to the **Main Take** and **deactivate Auto Takes**. **Copy** (**CTRL + c**) and **Paste** (**CTRL + v**) the **mantra_main_passes ROP** to create a copy of it. **Rename** this copy to **lit_fog_take**.



In the **Parameters** for the **lit_fog_take Mantra ROP specify**:

Render with Take **LIT_FOG_TAKE**

Images > Extra Image Planes

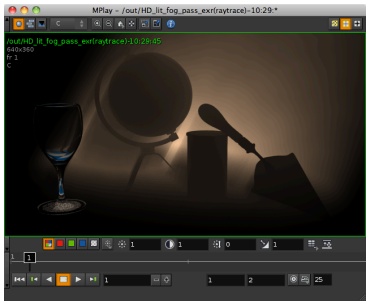
Shading Depth (Pz)

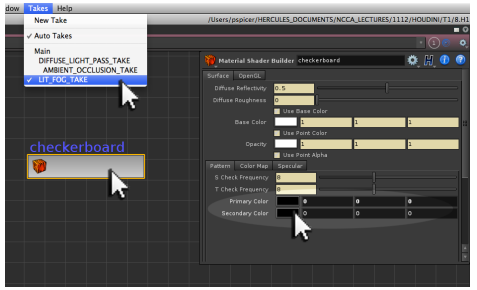
Extra Image Planes **0**

Rendering >

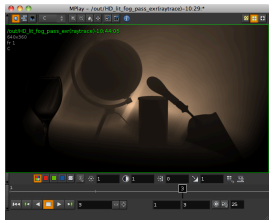
Rendering Engine **Ray Tracing**

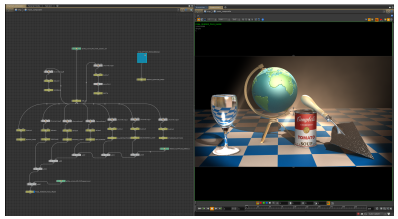
When the **lit_fog_take Mantra ROP** is **test-rendered**, everything looks correct apart from the **checkerboard ground** still **refracting** in the **wine glass** despite being activated as a Matte Shaded object. This can be rectified by **re-activating** the **LIT_FOG_TAKE** and **modifying** the **checkerboard material** to only render black.





As well as the Pattern > **Primary** and **Secondary Color parameters** needing to be set to black, the Specular > **Specular Intensity** parameter also needs to be set to **0**.





When the **lit_fog_take Mantra ROP** is **re-rendered**, the wine glass now returns the refracted fog elements of the scene. This additional render pass can then be rendered out at full resolution to test a single frame still frame composite of the scene.

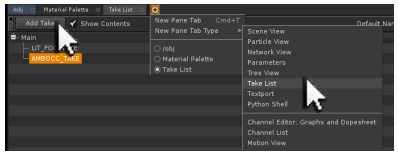
See file globe_passes_stage2.hipnc

NOTE: The Takes mechanism could also be applied to create base materials for a Caustics projection setup, where no textures are returned on the scene objects, but rather only a diffuse white surface (ie by deactivating any material texture maps, and specular highlights for materials so that they return a flat white colour).

NOTE: The Takes Mechanism can also be used to generate animation; where base animation could be stored in the Main Take, with other Takes created to store more refined animation work.

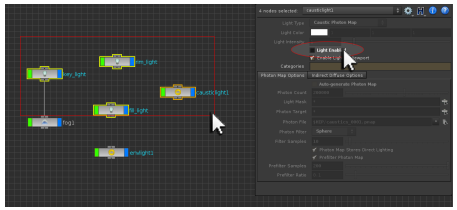
CREATING AMBIENT OCCLUSION

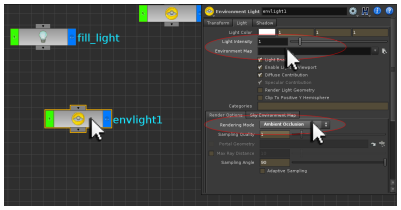
Ambient Occlusion is a custom render pass that has been partially superseded by Physically Based Rendering. It can however still be a useful render pass if additional shadow information is required. It can be **generated using a custom Take**. Over the **Network Editor**, **activate** a **Take List** as a **New Pane Tab Type**. Select the **Main Take**, and press the **Add Take Button**. **Rename** the new **Take** to **AMBOCC_TAKE**.



From the **Takes Menu**, **activate** both **Auto-Takes** and the **AMB_OCC_TAKE**. The scene is now ready to be configured for ambient occlusion.

In the **Network Editor**, select **all of the scene lights apart from the Environment Light** and **deactivate** the **Light Enabled** option in their combined parameters.





In the **parameters** for the **Environment Light** specify:

Light Intensity	**1**
Environment Map	**<empty>**
Rendering Mode	**Ambient Occlusion**

This will configure the Environment Light to generate Ambient Occlusion.

Head to **SHOP Level**. The **materials** for the scene can be **re-configured** in the context of the **AMB_OCC_TAKE** so that they **do not return** any **colour**, **specular**, **reflection** or **refraction** information.

Select the **soup_tin_label Material** and in its **parameters** specify:

Diffuse

Diffuse Intensity **0.5**

☐ **Use Color Map**

Reflect > Base

☐ **Enable Base Reflections**

In the **parameters** for the **chrome Material** specify:

Diffuse

Diffuse Intensity **0.5**

Reflect > Reflect Lights

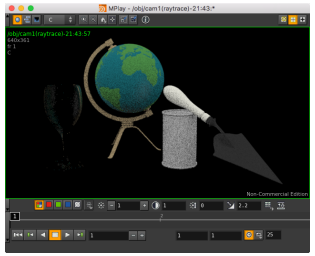
Specular Intensity **0**

Surface > Reflect > Reflect Objects

☐ **Reflect Objects**

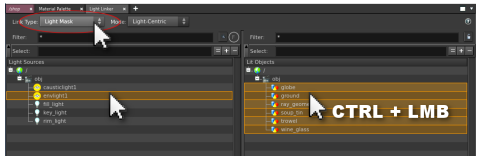
This will turn the soup tin into the same plain diffuse surface required for an Ambient Occlusion Render Pass.

NOTE: By default the chrome Material has a different Diffuse Intensity to standard materials; hence increasing it to match the standard value.



RMB on the **Film Spool button** of the **Scene View** and choosing **Mantra**, will render the scene using an **internal default mantra node** without interference from the main render mantra ROPs.

Activate a **Light Linker**, and under the **Light Mask section**, **reactivate** the **light link** between the **Environment Light** and the **ground object**.



At **SHOP Level**, in the **parameters** for the **checkerboard Material** specify:

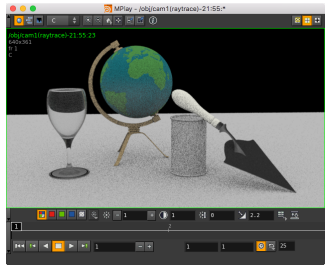
Pattern >

Secondary Color **1** **1** **1**

Specular >

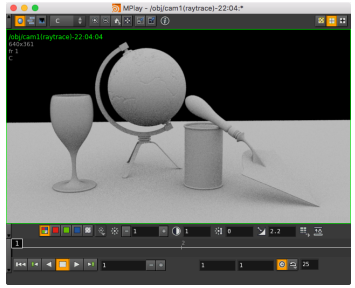
Specular Intensity **0**

This will **restore** the **ground object** to the **render**, and turn the **checkerboard material** into the **plain diffuse surface required** for an Ambient Occlusion Render Pass.



Continue to **work through the remainder Materials**, modifying their parameters to create a plain diffuse return in the render.

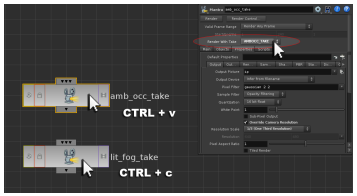
All materials should end up with a base colour of white and a Diffuse Intensity of 0.5; with no reflection or refraction properties. Any active Displacement or Bump on the Materials must however remain untouched.



As a final step, increase the **Sampling Quality** of the **Environment Light** to **5** to increase the quality of the Ambient Occlusion Pass.

With the scene has been configured for Ambient Occlusion, **reset** the scene back to the **main Take**, and at **Outputs Level**, create a **custom Mantra ROP** to render out the **AMBOCC_TAKE**. **Copy** (**CTRL + c**) and **Paste** (**CTRL + v**) the **lit_fog_take Mantra ROP**, renaming the copy to **amb_occ_take**. In the **parameters** for the **amb_occ_take Mantra ROP** specify:

Render with Take **AMBOCC_TAKE**



When the **amb_occ_take Mantra ROP** is formally rendered, an ambient occlusion render pass will be generated.

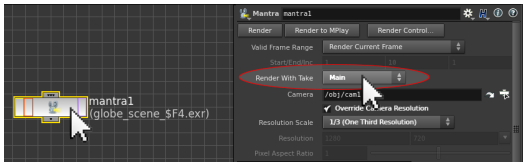
See file globe_scene_passes_stage3.hipnc

CONFIGURING THE PRIMARY MANTRA AND DAISY CHAINING MANTRA ROPS

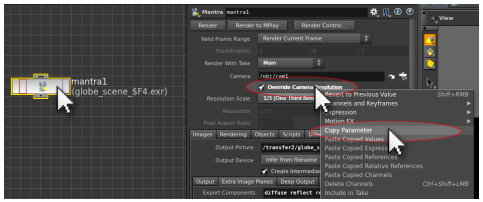
Before final rendering begins, the primary Mantra ROP need to be set explicitly to render with the main Take. This will prevent inadvertent rendering of the other Takes, as by default a mantra node will render with any current Take activated.

In the **parameters** for the **mantra1 node**, specify

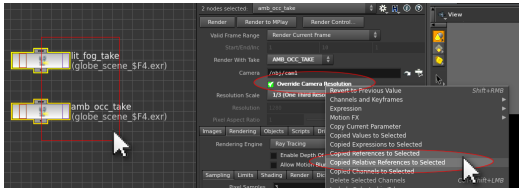
Render With Take **Main**



Channel Referencing can also be used to **control parameters** of the **lit_fog_take** and **amb_occ mantras** using the **primary mantra node**. **RMB** on the **Override Camera Resolution tick** box, and from the **resulting menu choose Copy Parameter**.



Select both the **lit_fog** and **amb_occ mantra nodes**, and in their **combined parameters**, **RMB** on the **Override Camera Resolution tick** box, and from the **resulting menu choose Copied Relative References to Selected**.



NOTE: The **Override Camera Resolution tick box** parameter will **turn green** to indicate the channel reference.

Create Channel Renferences from the **primary mantra node** to **control** the following **parameters** on the **lit_fog** and **amb_occ mantras**:

Valid Frame Range
Start/End/Inc
Camera
Rendering > Sampling
Pixel Samples
Min Ray Samples
Max Ray Samples

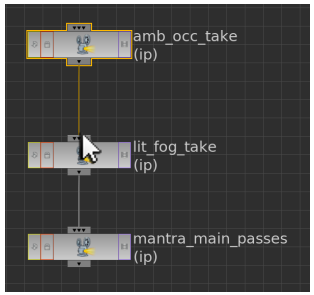
NOTE: The **Start/End/Inc parameter** will need the **Valid Frame Range parameter** of the **primary mantra node activated** as **Render Frame Range** to **allow** for the **Copy Parameter** mechanism to work.

As a **final step**, **specify** the **Images > Output Picture parameter** to the **following locations** for each mantra node:

mantra1	**Output Picture**	**/transfer/renders/globe_scene_$F4.exr**
lit_fog_take	**Output Picture**	**/transfer/renders/globe_scene_LF_$F4.exr**
amb_occ_take	**Output Picture**	**/transfer/renders/globe_scene_AO_$F4.exr**

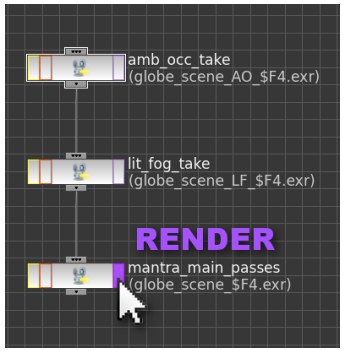
NOTE: Mantra nodes now by **default** will **Create Intermediate Directories**.

The **configured Mantra ROPs** can be **daisy-chained together** similar to **parenting**.



Doing this will **cause** the **main_passes Mantra ROP** at the end of the chain **to invoke** the **higher up Mantra ROPs to render first**.

If the **mantra_main_passes ROP** is **rendered**, the **first frame** of the **amb_occ_take ROP** will be **rendered**, **followed** by the **first frame** of the **lit_fog_take ROP**, and then finally the **first frame** of the **mantra_main_passes ROP** will be rendered. This daisy chain mechanism will continue until all frames have been rendered.

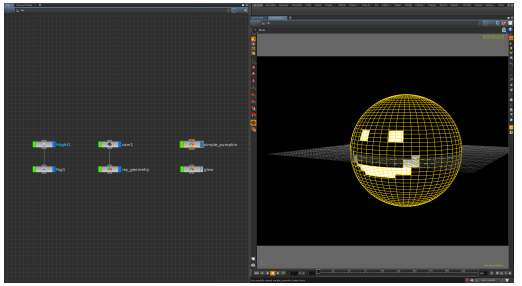


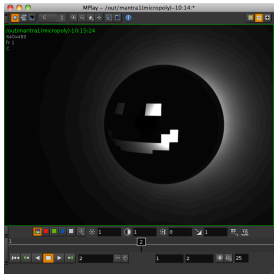
This means **complex render setups** can be **rendered in one go**, **simply** by **activating** the **final Mantra ROP** in the **daisy-chain**. This can be **useful** for **script-based** activation of **rendering** (such as activating renders on a Render Farm).

See file globe_scene_passes_complete.hipnc

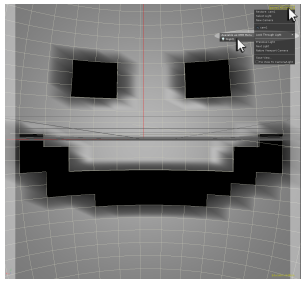
SHAPE PROJECTION GLOW

Open the scene **simple_pumpkin_begin.hipnc**. This scene contains a basic pumpkin object with a light inside it. A render of the scene reveals that Lit Fog has also been assigned to this light, but at present, **the associated fog effect goes around the pumpkin** rather than shining through the holes in the face.





In the **Viewer**, look through the scene light. In order to create a fog effect that shines only through the face holes, a render must be generated of this view and turned into a light mask.



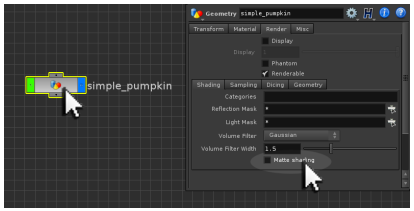
Switch to **OUT Level**, and create a new **Mantra ROP**. Rename it to **view_from_light**.

In the **Parameters** for the **view_from_light Mantra ROP** specify:

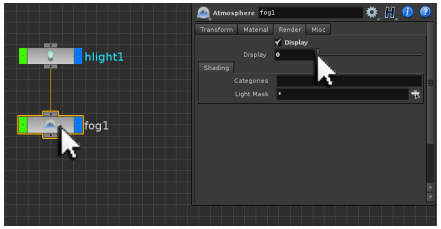
	Camera	**/obj/hlight1**
Properties > Output		
	☑ **Override Camera Resolution**	
	Resolution Scale	**User Specified Resolution**
	Resolution	**1024** **1024**

Before this Mantra ROP can be rendered, some settings at **OBJ Level** must be modified. At the moment, the **pumpkin object** is set to render as **Matte Shading** and the **Lit Fog** effect itself will obscure the light view render.

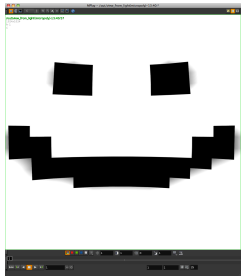
At **OBJ Level**, temporarily **deactivate** the **Matte Shading option** for the **simple_pumpkin** object.



Similarly, in the **parameters** for the **Atmosphere Object** parented to the scene light, set the **Display** parameter value to **0**.



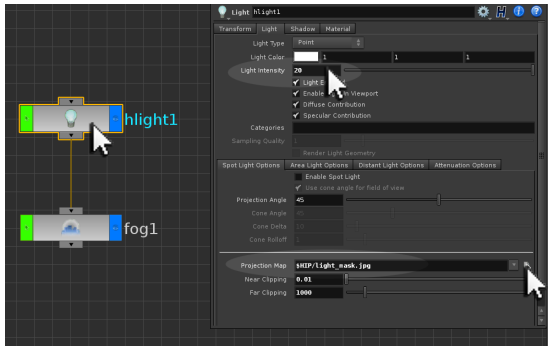
This will allow the view of the light to be rendered using the **view_from_light Mantra ROP**.



This **image** can **be saved to disk** and **inverted/cleaned-up** to create a **Light Mask** that can be reassigned to the light object.

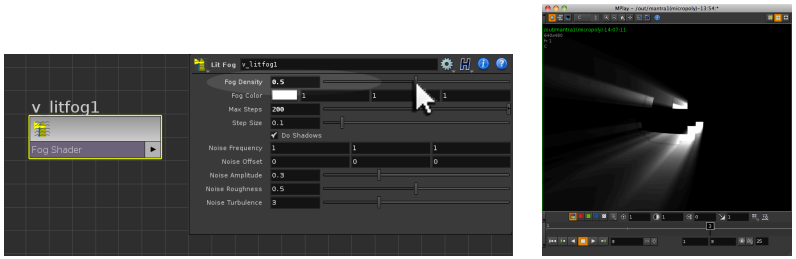
A **light mask** is a **black and white image** where **white regions** will **allow light** to pass through, and **black regions** will **stop light** from emitting.

As a light mask for this scene has already been created, it can be assigned to the light object in the scene. In the **parameters** for the scene light, load in **light_mask.jpg** to the **Project Map** parameter. Also increase the **Light Intensity** parameter to **20**.



In the **Parameters** for **simple_pumpkin** object **reactivate** the **Matte Shading** option, and in the **Parameters** for the **Atmosphere Object** reset the **Display** value to **1**.

As a final step, switch to **SHOP Level** and increase the **Fog Density** parameter of the **Lit Fog shader** to **0.5**.

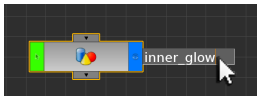


When the scene camera is rendered, the effect of the light mask on the lit fog can be seen.

NOTE: The Attenuation on this pumpkin light is activated as Physically Correct.

ADDING INTERNAL GLOW

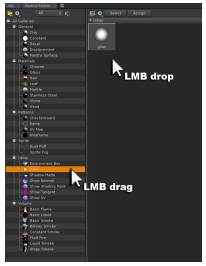
While the light mask is doing a good job in terms of directing the fog light effect, a **faux light source** can be added to the **interior** of the **simple_pumpkin object** to help convey a sense of light bouncing around its internal structure.

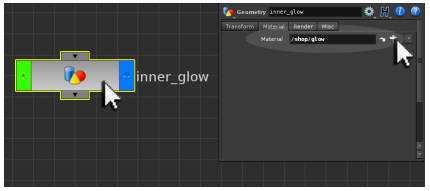


At **OBJ Level**, create a **Sphere Object** and **rename** it **inner_glow**. At its **Geometry Level**, activate the **parameters** for the **Sphere SOP** specifying:

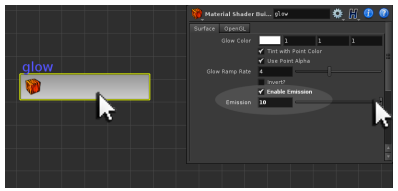
Radius	**2.5**	**2.5**	**2.5**

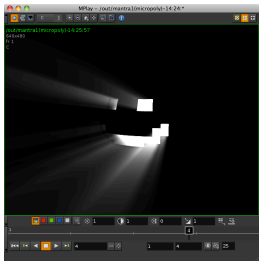
Activate the **Material Palette**, and **LMB Drag** and **Drop** a **Glow Material** into the **/shop palette region**. A Glow Material is a useful way to generate light bulb effects.





Back at **OBJ Level**, assign the **Glow Material** to the **inner_glow** object.
The Material parameter **Jump button** can be used to take Houdini to **SHOP Level** in order to configure the Glow Material Parameters.





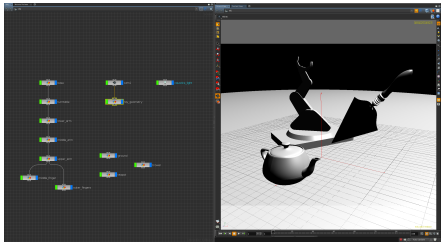
At **SHOP Level**, **activate** the **Enable Emission** parameter, and **increase** the **Emission** value to **10**. When the **scene is re-rendered**, both the **inner glow** and **lit fog** can be seen.

This combination of Glow Materials, Light Masks and Lit Fog can also be used to create torchlight effects.

See file simple_pumpkin_done.hipnc

SIMPLE CAUSTICS

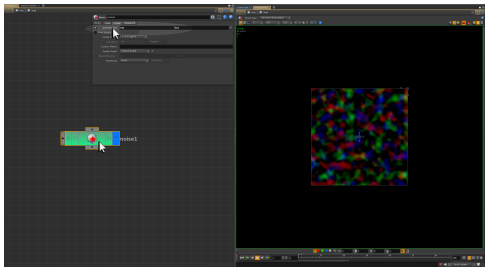
When a **sea** or **water surface** is **not visible** from the **camera view**, **projecting** an **animated caustics pattern through** a **scene light** can **generate** simple **underwater caustics**. **Open** the scene **simple_caustics_begin.hipnc**. This scene contains some geometry objects illuminated by a spot light called **caustics_light**.



Switch to the **/IMG Level** of Houdini and create an **Image Network**. The compositing level can be used to generate a simple caustics pattern. **Inside** the **img1 network**, create a **Noise COP**. In its **parameters** specify:

Image >

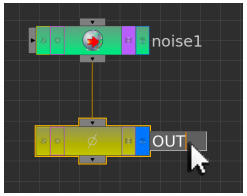
☑ **Override Size** **512** **512**



This will create a basic noise pattern for the caustics effect.

PROJECTING COP IMAGES THROUGH LIGHTS

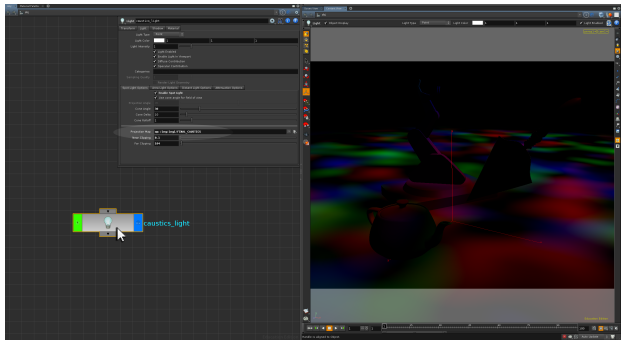
Append to the **Noise COP** a **Null COP** and rename it to **OUT**. This will create a node that the scene light can reference.



At **OBJ Level**, locate the **caustics_light** and in the **Light > Spot Light Options** section of its **parameters** specify:

Projection Map **op:/img/img1/OUT**

This will use the noise pattern as an image projection through the light.



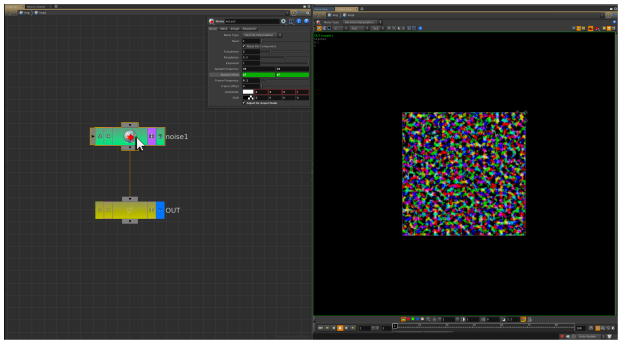
Now whatever modifications are made to the compositing network will automatically get passed to the caustics_light.

NOTE: During testing of simple caustics effects, the Noise COP pattern can be projected through the scene light without having to be rendered out as an image sequence beforehand. When testing is complete an image sequence of the caustics pattern must be rendered to disk and re-assigned to the light before final scene rendering begins.

Return back to the **IMG Level** of Houdini, and in the **Noise** section of the **parameters** for the **Noise COP** specify:

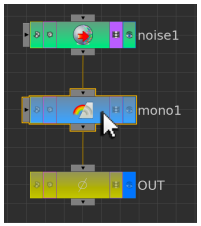
Noise >			
Turbulence	**2**		
Spatial Frequency	**30**	**30**	
Spatial Offset	**$F**	**$F**	
Frame Frequency	**0.1**		
Amplitude	**2**	**2**	**2**

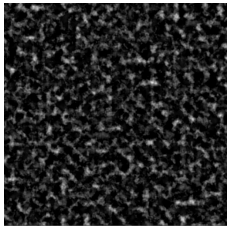
When **PLAY** is pressed, the noise animates in a similar way to a water surface.



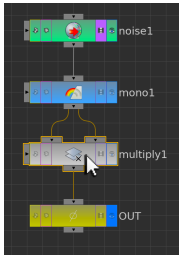
NOTE: While this animated noise will appear at IMG Level, it will not appear on the Scene Viewer until the sequence is rendered.

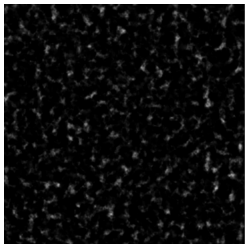
RMB insert a **Mono COP** after the **Noise COP**. This will turn the animated noise into a black and white image.



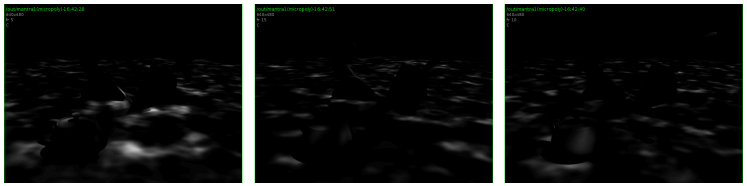


As a final step, the **output** of the **Mono COP** can be **multiplied on itself** in order to darken the caustics pattern.



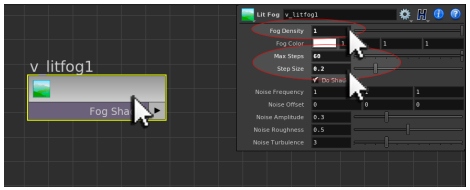


When an image sequence render of the scene is generated, the effect of the projected caustics pattern can be seen.

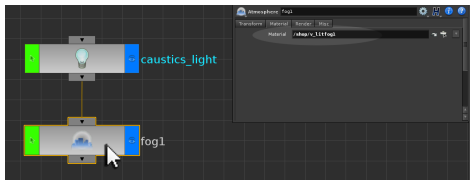


This projected light effect can be further enhanced by the **addition** of **Lit Fog**. Switch to the **SHOP Level** of Houdini, and create a **Lit Fog Shader**. In its **parameters** specify:

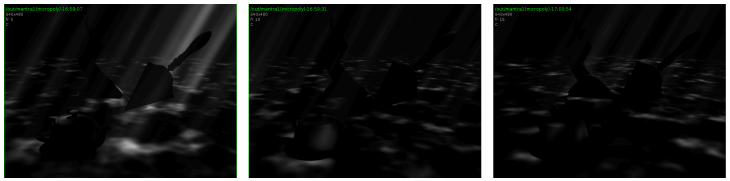
Fog Density	**1**
Max Steps	**60**
Step Size	**0.2**



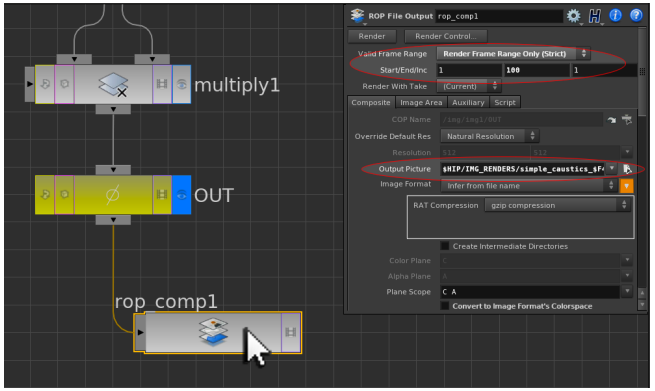
At **OBJ Level**, append an **Atmosphere Object** to the **caustics_light**. In the **Material** section of its **parameters**, load in the **Lit Fog shader**.



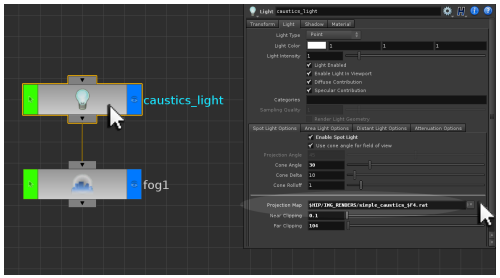
When the scene is rendered again, the caustics pattern is enhanced by Cathedral Rays that animates in accordance to the noise pattern of the caustics.



The pattern of the caustics can be played with further in order to enhance the effect. When the pattern is finalised, a **ROP File Output COP** can be appended to the **OUT Null COP** and the caustics pattern rendered out as a **.rat image sequence**.



When this image sequence has been created, the caustics_light in the scene can be pointed to it for its projection image.

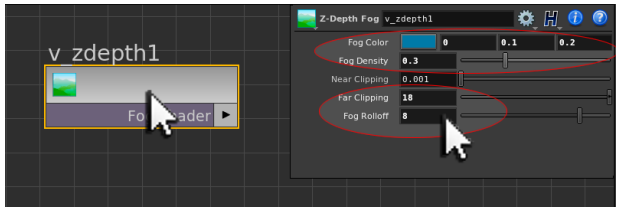


See file simple_caustics_stage1.hipnc

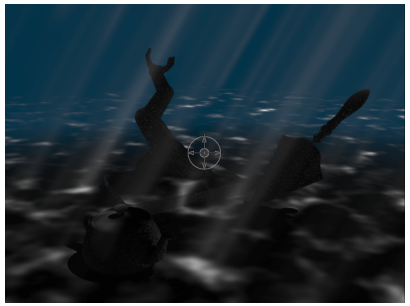
FURTHER ENHANCEMENTS

While this setup will generate a caustics/cathedral ray pass for the composite, additional fog effects can also enhance it. At **SHOP Level**, create a **Z-Depth Fog Shader**. In its **parameters** specify:

Fog Color	**0**	**0.1**	**0.2**
Fog Density	**0.3**		
Far Clipping	**18**		
Fog Rolloff	**8**		



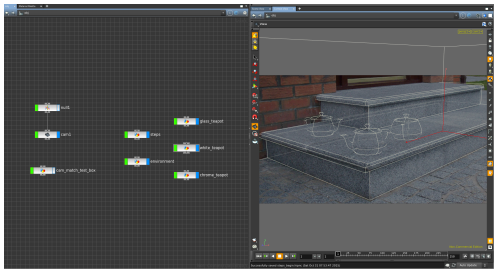
At **Object Level**, create an **Atmosphere Object** and rename it to z_depth_fog. When the Z-Depth Fog shader is applied, the cathedral rays now fall off into a foggy depth.



See file simple_caustics_complete.hipnc

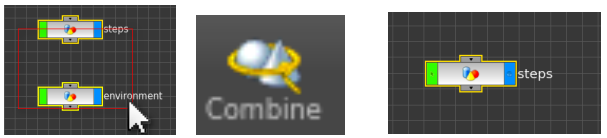
CAMERA PROJECTION TIPS

Open the scene steps_begin.hipnc. This scene contains **white**, **glass** and **chrome** teapots sat on simple steps geometry, which are aligned to a background plate. **Camera Projection** can be used to create **lighting**, **reflection** and **refraction** and **shadow** information for the teapot renders.

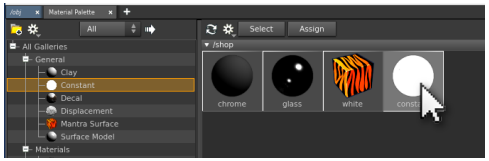


COMBINING DUMMY GEOMETRY

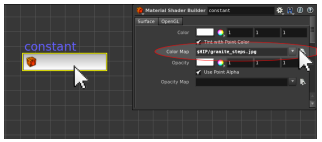
Select both the **steps** and the **environment objects**, and from the **Modify Shelf**, **activate** the **Combine Shelf Tool**. This will merge together both objects internal networks, using Transform SOPs to record any Object Level positioning.



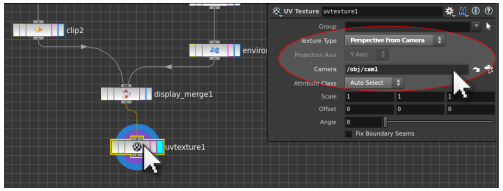
From the **Material Palette**, create a **Constant Material** and assign it to the newly combined steps.



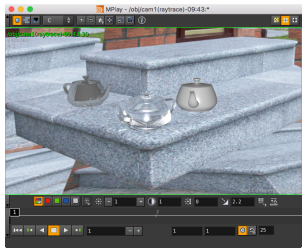
At **SHOP Level**, assign the **granite_steps.jpg** as the **Color Map**.



NOTE: Due to an **Open GL bug** in **H14**, **turn off** the **camera object's Background Image**, **save the scene** and **re-launch Houdini** before creating the camera projection.

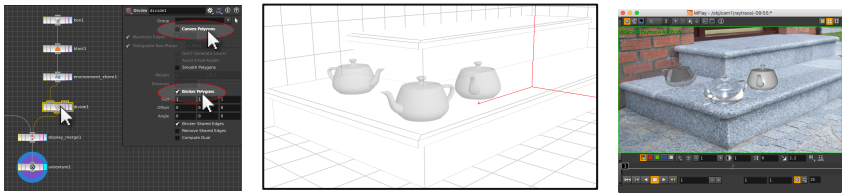


Inside the steps object, append a **UV Texture SOP** to the network, **specifying** a **Texture Type** of **Perspective from Camera**, and point the **Camera parameter** to **/obj/cam1**.



When the **scene** is **rendered**, the **camera projection** will **appear** on the **steps**. **Problems** can however be **seen with the environment**, as currently there is **not enough topology** to successfully **complete the projection** in these regions.

To the **environment network** in the **steps object**, **insert** a **Divide SOP** and **deactivate Convex Polygons**. When **Bricker Polygons** is activated, the **geometry** will be **sufficiently** divided to take the camera projection.

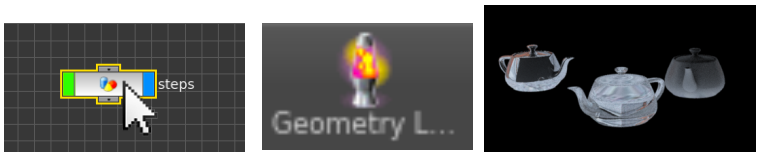


When the **scene** is **rendered again**, the **camera projection** works as expected. Reflections can be seen in the chrome teapot, and refractions in the glass teapot.

See file steps_stage_1.hipnc

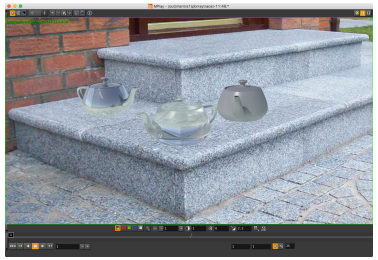
ADDING A GEOMETRY LIGHT

The **camera projection** can also be used for **lighting tricks** when assigned as a **Geometry Light**. At **Object Level**, **select** the **steps object** and from the **Lights and Cameras Shelf activate** the **Geometry Light**. This will turn off the steps object from the render.

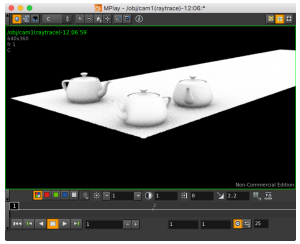


In the **parameters** for the **Geometry Light**, assign the **Constant Material** to the **Area Light Options > Material parameter**. When the scene is rendered again, the effect of the camera projected geometry light can be seen.

NOTE: Geometry Lights options include **Transform Into This Object** (for importing animation) and **Render Light Geometry**.



The **scene** can be **further developed** with **additional lighting** (such as the **Sky Light**) or **additional Geometry Light camera projections** to **complete the darker areas** of the **render** that reveals the currently **empty space behind the camera**.



Displacement can also be assigned to a **second version** of the **camera-projected steps** to create geometry **for bespoke lighting effects** and **object shadows**. This can be **implemented** using a **Custom Take**.

See file steps_complete.hipnc