Cameras

Note that to change the Arnold camera settings, you need to use the Arnold tab in Maya’s Attribute Editor for the camera object (make sure you scroll down past the standard Maya ‘Camera Attributes’ tab to the tab marked Arnold and expand it):

Arnold provides the following camera types:

- Cylindrical Camera
- Fisheye Camera
- Orthographic Camera
- Perspective Camera
- Spherical Camera
- VR Camera

The perspective, or standard, camera is the most common. Both the perspective and fish-eye cameras provide depth of field and model the effect of altering the camera aperture. The orthographic, cylindrical and spherical camera types enable certain non-perspective views to be created but do not attempt to
model any real-world lens effects (they are normally used for creating environment maps).

**Common Camera Attributes**

**Exposure**

Simulates the effect of camera exposure (in a non-physical way). Increasing this parameter by a value of one gives you one stop up (doubles the brightness).

![Exposure Examples]

**Filtermap**

Weights the camera sample by a scalar amount defined by the shader linked to the filtermap. This shader will use as an input, u,v coordinates in image-space coords [0,1) and x,y in pixel coordinates. This allows you to darken certain regions of the image, perfect to simulate vignetting effects.

There is an optimization in place where if the filter returns pure black then the camera ray is not fired. This can help in cases such as when rendering with the fisheye camera where, depending on its autocrop setting, parts of the frame trace no rays at all.

![Filtermap Examples]

Circular ramp mapped to the camera's filtermap to create a vignette effect
**Rolling Shutter**

*Rolling Shutter* is used to simulate the type of rolling shutter effect seen in footage shot with digital cameras that use CMOS-based sensors such as Blackmagics, Alexas, REDs, and even iPhones. This method is implemented by rolling (moving) the shutter across the camera area instead of the entire image area all at the same time.

The *Rolling Shutter* direction specifies the direction that the rolling shutter takes place. The default is 'off' and can be set to 'top' (top to bottom being the most common scanning direction), 'bottom', 'left' or 'right'.

Interesting effects can be achieved when combining motion blur 'length' with rolling shutter:
Motion blur 'length' from 0 to 2

A scene that demonstrates the above effect can be found here.

**Rolling Shutter Duration**

With this parameter, it is possible to control the duration of exposure of the scanlines in a rolling shutter camera. Valid values for this parameter are in the 0 to 1 range, where a value of 0 gives you an instantaneous exposure of each scanline (the default value and the rolling shutter's previous behavior), and a value of 1 exposes every scanline for the entirety of the camera's shutter interval (the same result that a camera without rolling shutter would give).

Enable DOF

Enables depth of field effects.
Focus Distance

This is the distance at which objects appear in perfect focus, for a non-zero aperture value.

Aperture

<table>
<thead>
<tr>
<th>Aperture Size</th>
<th>0.000</th>
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<tbody>
<tr>
<td>Aperture Blades</td>
<td>0</td>
</tr>
<tr>
<td>Aperture Blade Curvature</td>
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<tr>
<td>Aperture Rotation</td>
<td>0.000</td>
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<tr>
<td>Aperture Aspect Ratio</td>
<td>1.000</td>
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Aperture Size

The radius of the aperture in world units. The smaller the aperture, the sharper the images (shallower depth of field). In the limit, a size of zero produces no depth of field blurring.
Aperture Blades

A number of blades (or polygon sides) of the polygonal aperture. 0 is considered a circle aperture.

Aperture Blade Curvature

The curvature of the polygonal aperture sides. A value of 0 means hard straight sides. Increasing this value results in progressively more curved edges, all the way to 1.0 which produces a perfect disk. Negative values produce a "pinched" or star-shaped aperture.

Aperture Rotation

Rotates the aperture by the specified number of degrees.
Aperture Aspect Ratio

Values bigger than one produce an elongated defocusing effect, reminiscent of an anamorphic lens, while a value less than one will squash it.

UV Remap

This parameter takes a 2D displacement image and uses it to distort the rendered output of the camera's lens. The left image below has been rendered using a colored ramp connected to the UV Remap attribute. In the right image, the same ramp texture has been distorted in a 2d image post-processing software package.
**Camera Motion Blur**

Enables you to turn camera motion blur on or off. "Use Global Settings" will use the value set in the motion blur tab from the MtoA global render settings. This option can be useful when there are multiple cameras in a scene that may or may not require motion blur. "Use Global Shutter" (enabled by default) signifies that the camera should use the values from the Render Settings, in the motion blur tab. When you want to set a specific shutter in the camera, you can disable "Use Global Shutter" and then it will be taken into account.

**Shutter**

**Shutter Start/End**

The shutter range of the camera can be defined by changing the shutter_start and shutter_end parameters. The value range should use the same time reference as the motion times. The default shutter_start of 0 and shutter_end of 1 means a full camera shutter range equivalent to the default motion blur range. A smaller range (0.0-0.5) will decrease the effective shutter aperture time and only show the first half of the motion.

**Shutter Type**

The filtering applied to time samples. By default, this is a box filter, with all time samples having the same weight. A triangle (or "tent") filter is also available which produces smoother trails.

Arnold supports custom shutter shapes with the **shutter curve** camera parameter. You can define as many points as required. Coordinates increase from 0 (corresponding to the shutter_start) to 1 (corresponding to the shutter_end). Values in the vertical axis must be non-negative, and it is not recommended to enter values above 1. The values are linearly interpolated between each point. In the examples below, you can see the effect different curve shapes have on the motion blur trail of a sphere that has been key-framed moving from left to right.

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When using uv_remap you should use the image shader's 'image.swrap clamp' and 'image.twrap clamp' attributes to minimize edge effects due to filtering.
Various custom camera shutter curve shapes