

I. The Virtual Camera

- A. Point of View - Much like lighting, you cannot render a 3-dimensional scene without a camera. Point of View is determined by the following things...
 - i. Camera Location or eye location
 - a. Where the camera is placed.
 - b. Specified as a triplet of XYZ coordinate values.
 - ii. Center of Interest or camera interest
 - a. Where the camera is looking.
 - b. Specified as a triplet of XYZ coordinate values.
 - c. Sometimes specified as XYZ rotational values.
- B. Camera Movement
 - i. Pan - Camera location remains fixed, while the center of interest is moved from left to right or up and down.
 - ii. Tumble (orbit) - Opposite of a pan, keeps the center of interest fixed, while the origin of the camera is moved from left to right or up and down.
 - iii. Track - Changing the camera location and the center of interest at the same time.
 - iv. Dolly - Both the camera and the center of interest are moved in or out along the Z axis.
- C. Camera Orientation
 - i. Pitch - Rotation about the X axis
 - ii. Yaw - Rotation about the Y axis
 - iii. Roll - Rotation about the Z axis
 - iv. Sometimes specified by a point in space that determines the up direction of the camera.
 - v. Zoom - Objects appear closer or farther away, however the camera position doesn't move.
 - a. Exaggerates perspective.
 - b. Zooming in - more exaggeration.
 - c. Zooming out - less exaggeration.
 - d. Difference between zoom and dolly.
- D. Optical Phenomena
 - i. Field of View (fov) - Objects that are too far to the left or right or too far above and below you are not visible, they are said to be outside your Field of View (fov).
 - a. Cone of Vision - Fov can be thought of as a cone-shaped area beginning at the eye and expanding outward the farther it gets from the eye. (Similar to spot light.)
 - b. Pyramid of Vision - Virtual camera's cone of vision. Fits the rectangular display of computer screens.
 - c. Pyramid shape is determined by the angle from top to bottom of the pyramid, otherwise known as the fov angle, or simply the Field of View.
 - d. Field of View is measured in degrees.
 - e. Large Fov angle = wide angle lens. Edges are warped with spatial distortion.
 - f. Small Fov angle = flattened images with little perspective distortion.
 - ii. Depth of Field
 - a. Phenomena where some objects in your field of view appear to be in focus and some appear out of focus.
 - b. Usually specified by two numbers indicating the nearest and farthest distances from the camera that will be in focus.
 - iii. Clipping Planes - when rendering a scene, the computer could theoretically keep looking deeper and deeper into space infinitely to resolve one pixel.
 - a. Areas outside the pyramid of vision are already clipped away.
 - b. Far Clipping Plane - Invisible plane beyond which nothing is rendered.
 - c. Near Clipping Plane - Invisible plane that prevents objects closer to the camera to be rendered.
 - d. Viewing Frustum - Combination of Near and Far clipping planes and the walls of the pyramid of vision. This is the visible area that will eventually be rendered.

II. Using Cameras - when you first open Maya, you receive four cameras by default. 3 orthographic cameras and 1 perspective.

- A. Creating Additional Cameras - **Create -> Camera**.
 - i. Generally the default settings will work fine until you get more advanced.
 - ii. All of the settings can be changed after creation in the camera's Attribute Editor.
 - iii. To create a camera for animating, use the **Animation Options** settings.

- a. Single node cameras can be hard to animate, because it isn't easy to control the up vector of the camera, or it's viewpoint.
 - b. Multi-node cameras provide you with separate nodes for controlling the cameras position and direction.
 - iv. You may create either a perspective, or orthographic camera.
- B. Camera view guides - GUI items that help you to determine what will and will not be recorded(rendered). Can be found under the **View -> Camera Settings**.
 - i. Film gate - represents the area of the camera's view that a real world camera would record on film.
 - a. Dimensions of the film gate represent the dimensions of the camera aperture.
 - b. Film gate shows what will be rendered, only if the aspect ratios of the film gate and resolution gate are the same.
 - c. Film gate settings can be changed in the Camera's **Attribute Editor**.
 - ii. Resolution gate - represents the area of the camera's view that will render.
 - a. Dimensions of the resolution gate represent the rendering resolution.
 - b. Rendering resolution is indicated at the top of the window.
 - c. Resolution gate can be changed in the **Render Globals** window.
 - iii. Field Chart - represents the twelve standard cel animation field sizes(12 field being identical to the rendering resolution.)
 - iv. Safe Action - indicates the region that you should keep all of your scene's action within.(Roughly 90% of the render resolution.)
 - v. Safe Title - indicates the region that you should keep all of your scene's titles(text) within.(Roughly 80% of the render resolution.)
- C. Camera Icons and Manipulators
 - i. **Display -> Show -> Cameras** - displays all of the camera icons in the view panels.
 - ii. Selecting cameras - there are two methods.
 - a. Use the Hypergraph
 - 1. First **Show -> Invisible nodes** in the Hypergraph menubar.
 - 2. Select the camera from the Hypergraph.
 - b. **View -> Select Camera** in the view panel menubar.
 - iii. Camera Manipulator Tool - select the camera and then the manip tool - **t** .
 - a. Cycling index - clicking on the light blue cycling index displays interactive adjustment tools for specific attributes.
 - b. Center of Interest - lets you move both the camera and the center of interest with two separate translate pivots.
 - c. Pivot - let's you interactively change the cameras pivot point for subsequent transforms, then return to the cameras default pivot.
 - 1. Click on the pivot point icon after moving it.
 - 2. This locks the pivot in place.
 - 3. After performing transforms on the camera, enter the Manip tool and toggle the pivot off.
 - d. Clipping planes - allows you to change the near and far clipping planes interactively.
- D. Setting up a Camera - open the camera's Attribute Editor to edit it's settings.
 - i. Camera Attributes -
 - a. Angle of view - the angle in degrees of the camera's view of a scene.
 - 1. Increasing the aov zooms the camera out and decreases the size of objects.
 - 2. Decreasing the aov zooms the camera in and increases the size of objects in the scene.
 - 3. Increasing aov decreases the focal length.
 - 4. Decreasing the aov decreases the depth of field.
 - b. Focal length - related to aov, if you change one, the other changes automatically.
 - c. Clip Plane - you can set the clipping plane here.
 - ii. Film Back - were you can reference your digital camera to a physical model, such as 16mm, etc.
 - iii. Depth of Field - use this area to turn DOF on.
 - a. Focus Distance - The point from the camera where you want the image to be sharply in focus.
 - b. F Stop - controls the range of distances from the cameras focus point where objects are in focus.
 - c. Focus Region Scale - scales the focus value.

- d. Focus Distance, F Stop, Angle of View, and Focal Length all interact to generate Depth of Field. For a definitive study on the topic, pick up the American Cinematographers manual.
 - e. For ease of calculations, switch your Units preference to inches.
Options -> General Preferences -> Units.
 - iv. Special Effects - shutter angle. Used in determining the amount of motion blur based on a physical model.
 - v. Display options - toggle on camera guides and tools.
 - a. Film gate - very help to see the physical model of your aperture.
 - b. Resolution gate - good debug tool to see what exactly is going to be included in the render.
- III. Maya Interface and Cameras
 - A. Bookmarking - a way to organize and store saved camera views.
 - i. **View -> Bookmarks -> Edit Bookmarks** to create a new bookmark.
 - ii. Select **New Bookmark** to create a new bookmark.
 - iii. Type in a name for the bookmark, then click **Apply**.
 - iv. Click the **Close** button.
 - B. **View -> Bookmarks->** to select the view you wish to load.
 - C. Faster Rendering - disable depth of field, or increase your F Stop to increase the DOF to infinity.
 - D. Use the render Globals to match the Resolution gate to the Film Gate.
 - i. Custom - should be used to manually set the Resolution Gate.
 - ii. Resolution - where you can change the width and height of your final render.
 - iii. Change the device aspect ratio to match that of your Film Gate.
- IV. Preferences
 - A. User states and Maya preferences - Maya doesn't explicitly save your window states, or dialog settings for some of the most basic items, such as the Render Globals. You must **Options -> Save preferences** to have them defaulted.
 - B. **General Preferences > Units** allows you to change to a more user friendly inches unit for all of your operations, instead of the default cm.