Exposure Analysis with Histograms

- In photography, “exposure” refers to techniques that control the amount of light reaching the film.
- In computer graphics, “exposure” refers to the overall brightness of the scene.
- A histogram plots the number of pixels corresponding to each level of brightness.
- Exposure problems can show up and patterns in histograms.
Over Exposure Due to Excessive Intensity of Key Light

demo-13-overexposure.mb
Luminosity Histogram in Photoshop with Cliff at the Maximum Brightness Level: A Signature of Over-Exposure: overexposed.jpg
Under Exposure Due to Insufficient Intensity of Key Light

demo-13-underexposure.mb
Luminosity Histogram Showing only Half the Dynamic Range in Use: A Signature of Under-Exposure: underexposed.jpg
Camera Attributes

- Environment.
- Focal Length & Angle of View.
- Clipping Planes
- ...??...
Perspective and Focal Length

• The same scene area can be shot with cameras of different focal lengths.
• The focal length will influence the viewer’s sense of depth.
• Low focal length leads to a deep scene.
• High focal length leads to a shallow scene.
Focal Length: 35mm (Field of View: 54.43°; Tz = 3.41)

demo-13-focal-length-35.mb
Focal Length: 55mm (Field of View: 36.24°; Tz = 5.2)

demo-13-focal-length-100.mb
Focal Length: 100mm (Field of View: 20.41°; Tz = 9.5)
demo-13-focal-length-100.mb
Depth of Field

• A photographic lens is perfectly focused on objects at a specified distance.
• Objects closer or farther away are out of focus.
• Amount of blurring depends on aperture, measured in F-Stops.
• Depth of field can be simulated in Maya by a post-processing step that blurs each pixel by an amount that depends on its depth.
Depth of Field Effect: F Stop = 5.6

demo-13-depth-of-field.mb
Depth of Field Effect: F Stop = 16

demo-13-depth-of-field.mb
Camera Types

• Camera:
  – Useful when shooting a non-moving subject.
  – Useful when shooting with fixed aim from a moving vehicle.

• Camera and Aim:
  – Aim sub-object can be constrained or parented to a subject
  – Useful for tracking a subject that is moving.

• Camera, Aim and Up:
  – When is this useful?
  – Tracking a moving subject from a moving vehicle?
Animating the Camera

- Place aim sub-object at or near moving subject.
- Parent aim sub-object to moving subject.
- Erratic motion of subject leads to disturbing camera movements.
- Partition subject’s movements between group and child nodes.
- Parent aim sub-object to the group node.
Camera aim locator parented to bouncing ball:

demo-13-camera-tracks-ball.mb

demo-13-camera-tracks-ball.avi
Camera aim locator parented to parent of bouncing ball:

demo-13-camera-tracks-parent.mb

demo-13-camera-tracks-parent.avi
Exercise

• Make two geometric objects and two curves.
• Attach each object to a curve, as a motion path.
• Create a camera with aim.
• Point constraint the aim to the first geometric object.
• Point constrain the aim to the second geometric object.
• Now the camera tracks a point midway between the two geometric objects.
Aliasing

- Jagged boundaries result from sampling a continuous image at discrete pixel locations.
- Aliasing is a term from Signal Processing that is used to refer to this phenomenon.
- Anti-Aliasing techniques usually rely on super-sampling, i.e., breaking pixels into multiple sub-pixels and combining the results.
Anti-Aliasing

- Min and Max number of samples.
- Filter type determines how samples are arranged around the pixel.
- Contrast threshold determines when supersampling will be used.
Temporal Aliasing

- Suppose a scene has periodic motion.
- Suppose the period is roughly the same as the time separation between frames.
- The motion will be synchronized with the image sequence.
- The motion can appear speeded up, slowed down, stopped or reversed.
Rotating Wheel Example

Wheel subject to uniform angular acceleration. (It speeds up.)

demo-13-temporal-aliasing.mov
Motion Blur

• No Motion Blur:
  – Problems with temporal aliasing.
  – I.e., Synchronization of motion and frame rate.

• Motion Blur:
  – 2D: Fast but ugly: Combines images of objects in adjacent frames after they are rendered.
  – 3D: Slow and pretty: Renders each object in multiple positions in a single frame.

• Motion blur can be turned on or off for individual objects in the Render Stats tab of the Attribute Editor.
No Motion Blur:  demo-13-motion-blur.mb
demo-13-motion-no-blur.mov
2D Motion Blur (Blur-By-Frame = 1): demo-13-motion-blur.mb
demo-13-motion-2Dblur-bbf1.mov
2D Motion Blur (Blur-By-Frame = 2): demo-13-motion-blur.mb
demo-13-motion-2Dblur-bbf2.mov
3D Motion Blur (Blur-By-Frame = 1): demo-13-motion-blur.mb
demo-13-motion-3Dblur-bbf1.mov
3D Motion Blur (Blur-By-Frame = 2): demo-13-motion-blur.mb
demo-13-motion-3Dblur-bbf2.mov
Rotating Wheel Example

Motion blur diminishes effect of temporal aliasing.

demo-13-temporal-aliasing-2Dblur.mov

(Rendered with 2D motion blur with Blur-By-Frame = 2.)
Rotating Wheel Example

Motion blur diminishes effect of temporal aliasing.

demo-13-temporal-aliasing-3Dblur.mov

(Rendered with 3D motion blur with Blur-By-Frame = 2.)
Ray Tracing
Ray Tracing Terminology

- Incoming Ray
- Reflected Ray (R)
- Shadow Ray (L)
- Transmitted Ray (T)
Ray Tracing
Ray Tree
Sphere with Blinn Material Index of Refraction = 1.1
demo-13-refraction.mb
Sphere with Blinn Material Index of Refraction = 1.1

demo-13-refraction.mb
Sphere with Blinn Material Index of Refraction = 1.6
demo-13-refraction.mb
Use of Mental Ray to obtain blurred refractions.

demo-13-refraction-blur.mb
Reflecting Phong Material on Sphere over a Checkered Plane
demo-13-reflection.mb
Use of Mental Ray to obtain blurred reflections.

demo-13-reflection-blur.mb
Two Spheres with Reflecting Phong Material and Checkered Plane behind Camera

Reflection Limit = 1: demo-13-infinity.mb
Two Spheres with Reflecting Phong Material and Checkered Plane behind Camera

Reflection Limit = 2: demo-13-infinity.mb
Two Spheres with Reflecting Phong Material and Checkered Plane behind Camera
Reflection Limit = 3: demo-13-infinity.mb
Two Spheres with Reflecting Phong Material and Checkered Plane behind Camera

Reflection Limit = 4: demo-13-infinity.mb
Two Spheres with Reflecting Phong Material and Checkered Plane behind Camera
Reflection Limit = 8: demo-13-infinity.mb
Photon Mapping
Simulating Indirect Lighting with Hidden Area Lights
demo-13-fake-indirect-light.mb
Photon Mapping in Mental Ray:

Global Illumination Accuracy = 1; Global Illumination Radius = 1

demo-13-photon-mapped-indirect-light.mb
Photon Mapping in Mental Ray:

Global Illumination Accuracy = 800; Global Illumination Radius = 20

demo-13-photon-mapped-indirect-light.mb
Photon Mapping in Mental Ray:

Caustics Accuracy = 1; Caustics Radius = 1

demo-13-photon-mapped-caustics.mb
Photon Mapping in Mental Ray:

Caustics Accuracy = 500; Caustics Radius = 5

demo-13-photon-mapped-caustics.mb
Ambient Occlusion in Mental Ray: Shading of a point is determined by estimating the effects of nearby objects in occluding the ambient light in the scene. Mental Ray shoots rays from a surface point into a hemisphere to estimate occlusion: demo-13-ambient-occlusion-lambert.mb
Ambient Occlusion in Mental Ray: Shading of a point is determined by estimating the effects of nearby objects in occluding the ambient light in the scene. Mental Ray shoots rays from a surface point into a hemisphere to estimate occlusion: demo-13-ambient-occlusion-shader.mb