

Graphics Systems and Models

Tom Kelliher, CS 320

Feb. 3, 2003

1 Administrivia

Announcements

Change to course description. Additional prerequisite: must know what a “pixel” is.

Assignment

Read 2.1–4.

From Last Time

Pointers and memory allocation in C. How’s that project coming along?

Outline

1. CG Applications.
2. Graphics Systems Components.
3. Objects and Images.
4. Vision.

5. Pinhole and Synthetic Cameras.

6. Graphics Pipeline.

Coming Up

OpenGL introduction lab.

2 CG Applications

1. Entertainment: Lord of the Rings, Star Wars.

(a) Not real-time: can use model-render paradigm.

(b) *Lots* of off-line compute cycles. Good physics.

(c) High quality results.

2. Games: Quake, etc.

(a) Real-time, interactive.

(b) Lots of on-line compute cycles.

(c) Procedural physics: fast, not too accurate.

Real physics: lots of compute cycles (slow), accurate.

3. Simulation: Well, a surgical simulation is “like” a game.

3 Graphics System Components

Frame buffer attributes:

1. Unit: picture element (pixel).
2. Discretization process (rasterization): geometry info to raster (array or line of pixels).
3. Depth: 1, 8, 16, 24 bits.
4. Resolution: 640×480 , 800×600 , 1024×768 , etc.
Aspect ratio.

4 Objects and Images

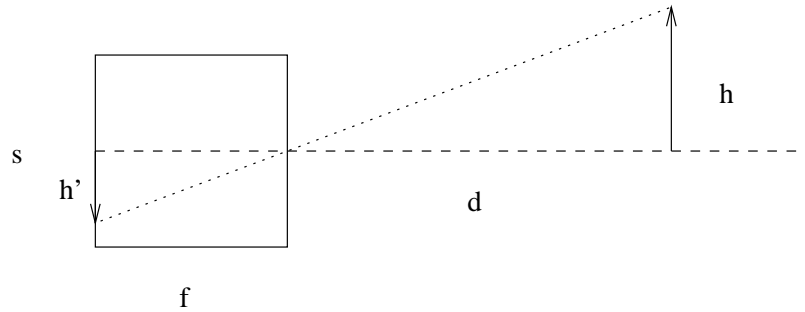
1. In any visualization process, painting, photography, etc., there are two key elements: object and viewer.
Object exists independently.
Its image is dependent upon view and other things such as light.
2. In CG, an image is composed of “polys” — usually triangles.

5 Vision

1. Human vision: rods (night) and cones (day).
Visual acuity: resolution.
Three types of cones, each most sensitive to a particular light frequency (blue, green, yellow).
Response is non-linear for one type of cone and non-uniform between cones.
2. CG uses three color system of linear combinations of monochromatic red, green, blue.

6 Pinhole and Synthetic Cameras

Consider the project of an object of height h onto the focal plane of a pinhole camera:



1. What's the height of the image (h')?
2. What's the angle of the field of view?
3. Depth of field.
4. CG's synthetic camera adds a clipping rectangle to this basic set-up.
5. Independence of objects and camera.

7 Graphics Pipeline

1. 3-D points represented by four element vectors.
2. Transformations applied by multiplications by series of 4×4 matrices.
3. Stages:
 - (a) Transformer: rotate, shift, scale. Convert world coordinates to window coordinates.
 - (b) Clipper.
 - (c) Projector: 3-D to 2-D. Ortho, perspective views.
 - (d) Rasterizer.