Johns Hopkins
Engineering for Professionals

605.767 Applied Computer Graphics

Brian Russin

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

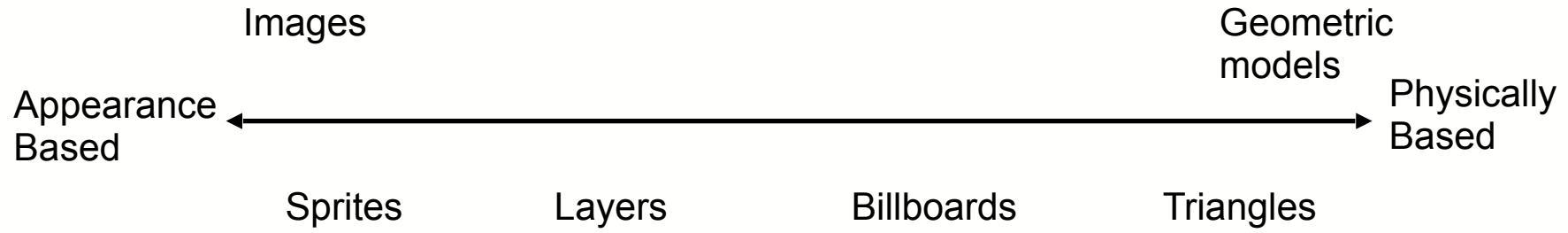# Module 9H
Image-Based Effects

Image Based Effects

- Chapter 10 discusses many **image based effects**
  - Skyboxes
  - Sprites
  - Billboarding
  - Imposters
  - Image processing
  - Color correction
  - Tone mapping
    - High dynamic range lighting
  - Lens flare and bloom
  - Depth of field
  - Motion blur
  - Fog
- For now just touch on a couple

Rendering Spectrum

Images

Geometric models

Appearance Based

Physically Based

Sprites   Layers   Billboards   Triangles

- Continuum of rendering techniques from Lengyel
- Show level of detail techniques
  - Used to improve speed
  - As object recedes from the viewer can substitute images for polygons

Skyboxes

- Environment maps can be used to represent distant objects
  - 6 faces of cube as drawn from camera location
- Show **parallax** effect
  - Shift of near objects in relation to far objects as camera moves
    - Near objects move while distant objects remain still
- Skyboxes replace distant geometry with texture maps
  - Cube maps are most common
  - Other shapes like a flattened dome (equirectangular) image can be used
- To work properly the skybox texture resolution should be approximately one texel per screen pixel
  - texture resolution = screen resolution / tan(fov/2)
- Downloadable skybox textures:
  - https://combineoverwiki.net/wiki/Category:Skybox_images_(Half-Life_2)
  - Mercator Images: https://stock.adobe.com/search?k=equirectangular
- Simple tutorial
  - http://sidvind.com/wiki/Skybox_tutorial

Sprites and Layers

- Sprites are 2D images that move around the screen
  - Many early computer games used sprites extensively
  - Simple sprites have a 1:1 mapping to screen pixels
- More general sprites can be a texture applied to a polygon that always faces the viewer
  - Can have transparency
  - A set of sprites may be used to simulate an object from different viewpoints
- One can think of a scene as a series of layers
 - As is done for 2D cel animation

Billboards

- Several graphics techniques render an image onto a polygon that faces the eye/camera
  - Orienting the polygon based on view direction is called **billboarding**
    - Polygon is called a **billboard**
  - As the view changes the orientation of the polygon changes
- Texture map can be used to replace complex geometry
  - Improve performance yet retain realism
  - Draw a complex object (such as a tree) with a simple planar texture mapped geometry
    - Transform geometry to face the viewer
    - Texture often has transparent regions
  - Text discusses using billboards to simulate clouds
  - An example is an **imposter** object
    - Application creates the texture dynamically
- Also see
  - http://www.flipcode.com/archives/Billboarding-Excerpt_From_iReal-Time_Renderingi_2E.shtml
  - http://www.vterrain.org/Plants/Modelling/

Billboards

- **Axial billboard** is a 2D object rotated about its y axis
  - Angle making it normal to the view direction
  - Translated to is position in the scene
- Modeling z-rotation is:

$$\theta = \cos^{-1}(V_b \cdot B_n)$$

  - B_n is the normal vector of the billboard
    - often (1,0,0)
  - V_b is the vector from the position of the billboard to the view point (in world coordinates)
- Works well if the object possesses cylindrical symmetry
  - If not, different texture can be used
    - Directional billboards
- Works well if viewing direction is primarily perpendicular to axis of symmetry
  - Doesn't work well looking "down" on the object
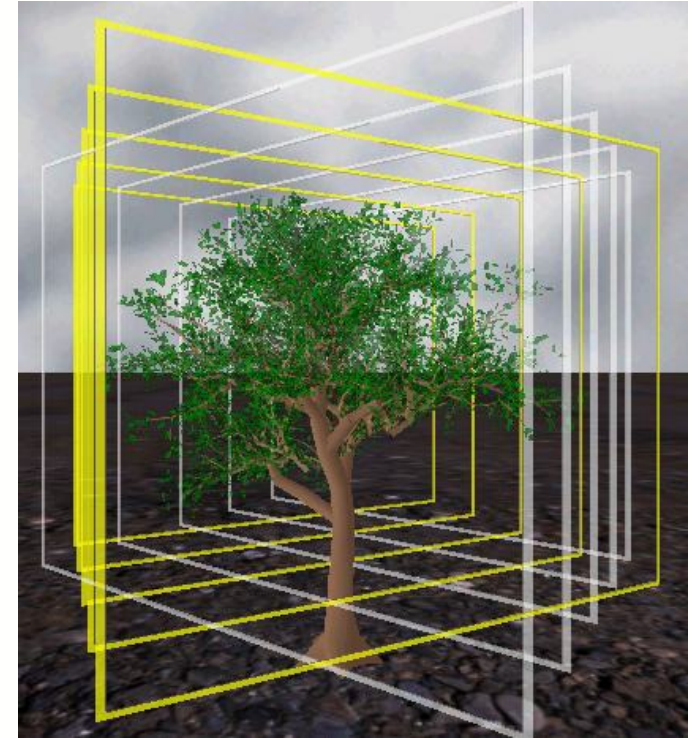
www.vterrain.org/Plants/Modelling

Image Processing

- Post effects of rendered image
  - Example: effects that mimic real camera artifacts like light glare
- Implementation
  - Render to a framebuffer object with texture memory
  - Use output as input to next pass
  - Combine textures for a final image
    - Often performed in 2D space
    - Figure 12.5 (10.23 in 3rd Edition)
- Common image processing techniques
  - Blur
  - Sobel Edge Detection
    - enhance cell shading
  - Bloom or glare
    - https://learnopengl.com/Guest-Articles/2022/Phys.-Based-Bloom

Bloom Effect

WITHOUT BLOOM

WITH BLOOM

https://learnopengl.com/Advanced-Lighting/Bloom