Some Visual Techniques in OpenGL

Blending

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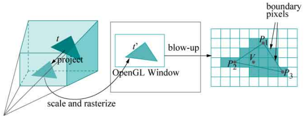
Recall rasterization:

- Triangle vertices are projected to screen space.
- Pixels associated with triangle are found.
- Color value and z-value (depth) calculated for each (often using interpolation on vertex values, as well as texture look-ups).



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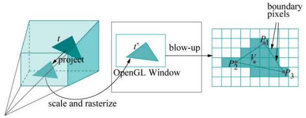

Fragment = pixel coordinate + calculated color value and z-value. (A "potential" pixel in the final picture).

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Exactly how can be set in various way in OpenGL. Note: the averaging takes place individually on each of the color channels (including A-channel).

Blending Example

A typical example:

```
glEnable(GL_BLEND);
glBlendFunction(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
```

$$\text{Dest}_X = \text{Source}_{\text{alpha}} \cdot \text{Source}_X + (1 - \text{Source}_{\text{alpha}}) \cdot \text{Dest}_X$$

for X = red, green, blue, alpha. Dest is colorbuffer pixel value, Source is fragment value.

(All resulting channel values clamped to 1.0.)

Applications

Blending useful for e.g.:

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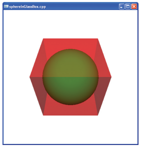
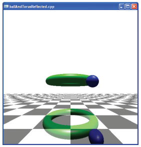
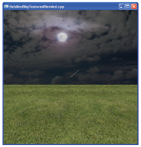
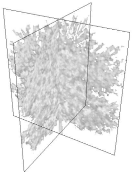






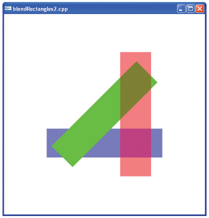


(From OpenGL Programming Guide)

Translucent Objects

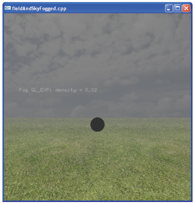
Drawing translucent objects:

- First draw all opaque objects (no blending)
- Then draw all translucent objects, with blending enabled, in back-to-front order wrt. the viewer [BSP trees may be used].



Fog

Automatic depth-based blending with fog-color.



```
Fog GL_EXP: density = 0.02
```

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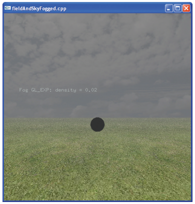
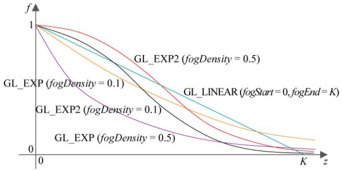
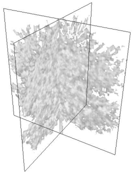


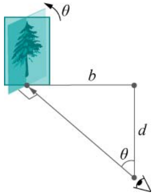
Various depth-functions can be chosen:



Billboards

A plain rectangle with a texture, simulating objects.



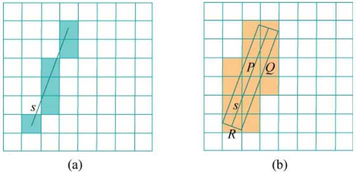


Useful for many things (especially when combined with translucent edges via blending), e.g.:

- Clouds
- Trees
- Laser beams
- Smoke
- Explosions

Anti-Aliasing

OpenGL may be asked to anti-aliase using blending.



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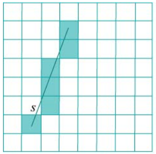
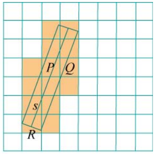


(a)



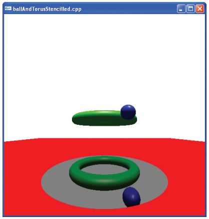
(b)

s

Another method is multisampling (several subpixels/rays per final pixel).

Further OpenGL Buffers

- Accumulation buffer: combining place for color buffer contents (entire pictures). Used for e.g. depth-of-field effects, motion blur effects.
- Stencil buffer: used to restrict drawings to various areas (think boolean bits per pixel - first set bits during a rendering to stencil buffer, then use bits during rendering to color buffer (stencil test)).



Picking

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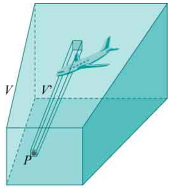
- Special render mode allows OpenGL to report on which rendered objects intersected the frustrum.
- You can name (number) the objects rendered.
- For each, OpenGL can report the min and max z-value inside the frustrum.
- GlU has command for setting up a pixes-wide frustrum.

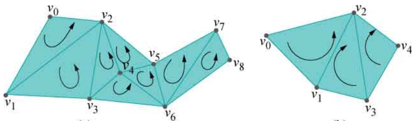


Viewing face

Orientation

Vertex order gives orientation on triangles [CCW side and CW side].

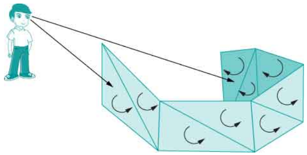
Several neighboring triangles: consistent orientation.

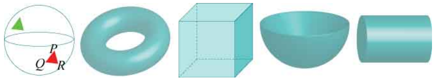


(a) (b)

Backface Culling

Save time by not shading backfacing triangles of closed objects.





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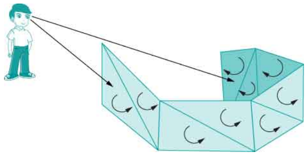
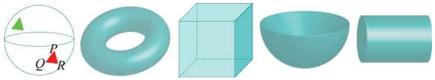
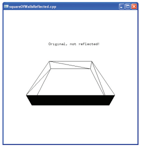
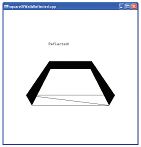




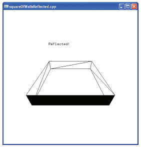
Note: reflections are orientation reversing transformations:



Original, not reflected!



Reflected!



Reflected!