Computer Graphics

Chapter 13

Blending

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Over operator

\( d' = a_s s + (1-a_s)d \)

Examples: \( a_s = 1 \) \( a_b = 0.4 \)

\( A \) over \( B \):
\[ d' = 1 \cdot C_A + (1-1) \cdot C_B \]

\( B \) over \( A \):
\[ d' = 0.4 \cdot C_B + (0.6) \cdot C_A \]

Comparison:
\[ d' = bs + cd \]

Over operator

\( d' = a_s s + (1-a_s)d \)

Examples: \( a_s = 0.4 \) \( a_b = 1.0 \)

\( A \) over \( B \):
\[ d' = 0.4 \cdot C_A + (0.6) \cdot C_B \]

\( B \) over \( A \):
\[ d' = 1 \cdot C_B + (0) \cdot C_A \]

Comparison:
\[ d' = bs + cd \]
Over operator

- \( d' = \alpha_s s + (1-\alpha_s)d \)
- \( d' = \alpha_s a_s + (1-\alpha_s) a_d \)

OpenGL Blending

- In OpenGL:
  - Enable blending
    - glEnable( GL_BLEND )
  - Specify alpha channel for colors
    - glColor4f( r, g, b, alpha )
  - Specify blending function
    - E.g: glBlendFunc( GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA )
    - \( C = \alpha_{new} * C_{new} + (1-\alpha_{new}) * C_{old} \)
  - Other options available

Double Buffering

- Framebuffer:
  - Piece of memory where the final image is written
  - Problem:
    - The display needs to read the contents, cyclically, while the GPU is already working on the next frame
    - Could result in display of partially rendered images on screen
  - Solution:
    - Have TWO buffers
      - Currently displayed (front buffer)
      - Render target for the next frame (back buffer)

Caveats:

- Note: alpha blending is an order-dependent operation!
  - It matters which object is drawn first AND
  - Which surface is in front
  - For 3D scenes, this makes it necessary to keep track of rendering order explicitly
  - Possibly also viewpoint-dependent!
    - E.g. always draw "back" surface first
  - Also note: interaction with z-buffer

Front/back buffer:

- Each buffer has both color channels and a depth channel
  - Important for advanced rendering algorithms
  - Doubles memory requirements!

Switching buffers:

- At end of rendering one frame, simply exchange the pointers to the front and back buffer
- GLUT toolkit: glutSwapBuffers() function
  - Different functions under windows/X11 if not using GLUT

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