Image Processing

CSCI 4830/7000
Advanced Computer Graphics
Spring 2010

Types of Image Processing

- Sample texture to generate image
  - Texture can be read from file
  - Generate texture on pass 1, process on pass 2
- Combing values from different textures
  - Differencing/merging images
- Combining surrounding values from one texture
  - Sharpen, blur, erosion, dilation, ...
  - Edge detection
  - Anti-aliasing

Image Processing by Shader

- Pixel value based on the pixels in the vicinity
  - Weighted average of group of pixels
    - Sum of weights should be one
    - Weights may be negative
  - Edge detection
    - Sum of weights should be zero
    - Some weights must be negative
- Fragment processing can get values from a texture by sampling
  - Need the image in a texture
  - For interactive graphics, need image -> texture

OpenGL Implementation

- Draw the scene
- Copy scene to texture
  - glCopyTexImage2D
  - Set pixel spacing
- Apply processing to texture
  - Identity projection
  - Draw quad size of window
  - Sample pixel from texture
- Can do multiple iterations

Framebuffer Implementation

- Procedure remains the same
  - Draw the scene to texture framebuffer
  - Apply processing to (framebuffer) texture
- Very efficient
  - No need to move buffers to and from video card
- Simple to implement
  - Allocate and size buffer
  - Switch destination with glBindFrameBuffer

Image Filters

- Sharpen (sum of weights=1)

  ```
  -1  -1   -1
  -1   9   -1
  -1  -1   -1
  ```

- Blur (sum of weights=1)

  ```
  1  2  1
  2  1  2   /  13
  1  2  1
  ```

- Erosion (minimum)

- Dilation (maximum)

Edge Detection

- Laplacian (sum of weights=0)

  -1 -1 -1
  -1 8 -1
  -1 -1 -1

- Prewitt $\sqrt{H^2+V^2}$

$$H = \begin{matrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{matrix} \qquad V = \begin{matrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{matrix}$$

- Sobel $\sqrt{H^2+V^2}$

$$H = \begin{matrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{matrix} \qquad V = \begin{matrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{matrix}$$