Image Processing

CSCI 4830/7000
Advanced Computer Graphics
Spring 2009

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 normally
- 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

Image Filters

- Sharpen (sum of weights=1)

$$\begin{array}{ccc} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{array}$$

- Blur (sum of weights=1)

$$\begin{array}{ccc} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & 1 \end{array} \quad / \quad 13$$

- Erosion (minimum)
- Dilation (maximum)

Edge Detection

- Laplacian (sum of weights=0)

$$\begin{matrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{matrix}$$

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

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