Feline: Fast, Elliptical Lines for Anisotropic Texture Mapping

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Outline

- What should texture mapping really do?
- Previous work
- Our work: Simple Feline
- Image gallery
- Conclusions
An Intuitive Diagram of Texture Mapping (stolen from Landsdale)

- Pixel filter is a window with variable transparency
- Filter weight at a point is degree of transparency
- A circular window views an elliptical texture area
- Adjacent filters overlap

Heckbert & Greene’s Elliptical Weighted Average (EWA)

- Assume perspective distortion is constant near pixel (99.9% true)
- Back mapping to screen space is a biquadratic
EWA Texturing Examples

- Nice definition to text without jaggies
- Few & faint Moiré artifacts

Lance Williams’ Mip-mapping with Trilinear Filtering

- Trilinear filter has (very) roughly circular contour lines, with a square footprint
Trilinear Texturing Examples

- 2^n trilinear probes along ellipse’s “major axis”
- Resulting filter is too short and mesa-like at best...

Texram (Best Case)
Texram (Worst Case)

... and jaggedly peaked at worst.

Texram Texturing Examples

Sharp text but with jaggies (aliasing)

Lots of swimming Moiré artifacts
**Exact Feline: Use Ellipse Parameters**

- n probes, Gaussian weighted, on major axis of ellipse
- Important Texram problems fixed
- But expensive setup comparable to EWA!

**Simple Feline: Approximate Ellipse**

- Approximate ellipse axes for cheaper setup
- Slightly underestimates major radius, overestimates minor radius (resulting in fewer, fatter probes)
Simple Feline: Reducing # of Probes

- Allow shortening of “major axis”
  - Extreme sensitivity, quickly causes aliasing
  - 3% decrease
- Allow widening probes
  - Causes blurring
  - Max of 16% (high-quality) or 31% (high-efficiency)
- Allow stretching distance between probes
  - Causes aliasing
  - Max of 15% (high-quality) or 36% (high-efficiency)

Simple Feline: Modest Probe Reduction

- Actual blur stretch of 15.6% (maximum allowed)
- Actual aliasing stretch of 7.0%
Simple Feline: “Texram Probe-Equivalent” Reduction

- Actual blur stretch of 31% (maximum allowed)
- Actual aliasing stretch of 26%

Simple Feline: “Texram Probe-Equivalent” with Gaussian Probes

- Blur stretch of 36%
- Slightly blurrier, but many fewer aliasing artifacts
Conclusions

- Feline compared to EWA:
  - High-Quality Feline's visual quality is comparable, using half the cycles/pixel and much smaller setup logic
- Feline compared to Texram:
  - High-quality images far superior, using more cycles/pixel
  - High-efficiency images superior, using same cycles/pixel
- Feline requires a tiny fraction of the die of a PC or next-generation game console graphics accelerator