Sampling and Anti-Aliasing

- Frequency vs. Space review
- Sampling Filters
- Integrating methods
- Supersampling
  - Adaptive
  - Jittered
  - Distributed
Frequency vs. Space review

- Neat dualities between Frequency and Spatial domains
  - Convolution $\leftrightarrow$ Multiplication
  - Finite $\leftrightarrow$ Infinite
  - Impulse $\leftrightarrow$ Sine function
  - Boxfunction $\leftrightarrow$ Sinc function

- Sharp edges require infinite extents
  - Cutting off (Windowing) outer range produces wiggles
  - Remember square wave example
  - Sharpness with ringing, or blur without
Sampling Filters

• Generally finite non-zero extent

• Sampling with filters
  – Position filter at sample point
  – Multiply image function by filter
  – Integrate result for sample value

• How to integrate?
  – Easy for constant (box) function
  – Build summing table for separable functions
  – 2d summing table for non-separable functions
  – Tables require rectangular areas
Integrating sampling methods

- Subpixel polygon algorithms (Crow, Catmull, Duff, Abrams et al)
  - Weighted vs. unweighted areas
  - Pixel areas should overlap (complicated)

- Beam tracing (Heckbertt and Hanrahan)
  - Uses notoriously difficult cookie-cutter algorithm

- Cone tracing (Amanatides)
  - Painful cone reflection calculations
  - Hierarchical cones suggested

• Highlights?
Supersampling

• Trace more rays, use higher resolution
  – Expensive

• Adaptive supersampling
  – Trace more rays where needed

• At pixel level
  – Weight with filter function
  – Distribute with filter function

• At image level
  – More samples needed in detailed areas, how?
Adaptive Sampling

- Look at local variance in coarse array of samples
- Take more samples in areas of high variance
- Coarser arrays risk missing small things
- Nonuniform samples require more thought for reconstruction
  - Fit surface to samples to resample for display
Jittered Sampling

- Aliasing vs. Noise
- Film emulsion
- What kind of jitter?
References

• Subpixel polygon algorithms
More References

– Beam, Cone tracing


Even More References

- Adaptive Supersampling

- Jittered Sampling