



Tamara Munzner

Antialiasing II

Week 11, Wed Mar 31

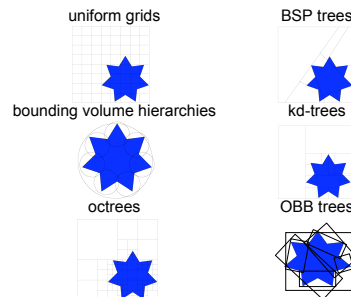
<http://www.ugrad.cs.ubc.ca/~cs314/Vjan2010>

News

- P4 proposals due now
 - don't wait for feedback from me to start! you'll only hear from me if there's a problem
- typo on P4 writeup
 - it's worth 15% of grade not 18%

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Review: Spatial Data Structures



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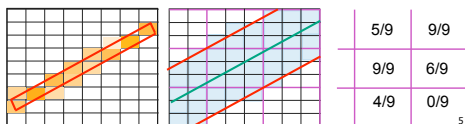
Review: Aliasing

- incorrect appearance of high frequencies as low frequencies
- to avoid: **antialiasing**
 - supersample
 - sample at higher frequency
 - low pass filtering
 - remove high frequency function parts
 - aka prefiltering, band-limiting

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Review: Supersample and Average

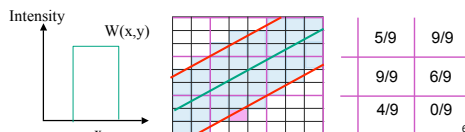
- supersample: create image at higher resolution
 - e.g. 768x768 instead of 256x256
 - shade pixels wrt area covered by thick line/rectangle
- average across many pixels
 - e.g. 3x3 small pixel block to find value for 1 big pixel
 - rough approximation divides each pixel into a finer grid of pixels



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Supersample and Average

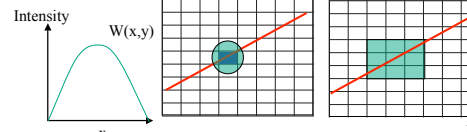
- supersample: jaggies less obvious, but still there
 - small pixel center check still misses information
 - unweighted area sampling
 - equal areas cause equal intensity, regardless of distance from pixel center to area
 - aka box filter



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Weighted Area Sampling

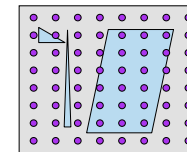
- intuitively, pixel cut through the center should be more heavily weighted than one cut along corner
- weighting function, $W(x,y)$
 - specifies the contribution of primitive passing through the point (x, y) from pixel center
 - Gaussian filter (or approximation) commonly used



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Sampling Errors

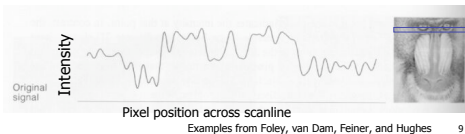
- some objects missed entirely, others poorly sampled
 - could try unweighted or weighted area sampling
 - but how can we be sure we show everything?
- need to think about entire class of solutions!
 - brief taste of signal processing (Chap 4 FCG)



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Image As Signal

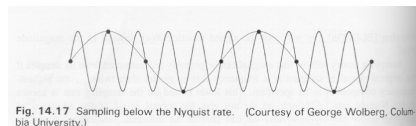
- image as spatial signal
- 2D raster image
 - discrete sampling of 2D spatial signal
- 1D slice of raster image
 - discrete sampling of 1D spatial signal



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Sampling Frequency

- if don't sample often enough, resulting signal misinterpreted as lower-frequency one
 - we call this **aliasing**



Examples from Foley, van Dam, Feiner, and Hughes 10

Sampling Theorem

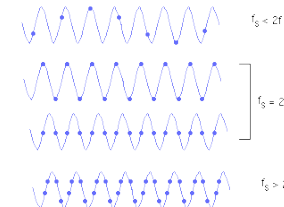
continuous signal can be completely recovered from its samples
iff
sampling rate greater than twice maximum frequency present in signal

- Claude Shannon

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Nyquist Rate

- lower bound on sampling rate
 - twice the highest frequency component in the image's spectrum



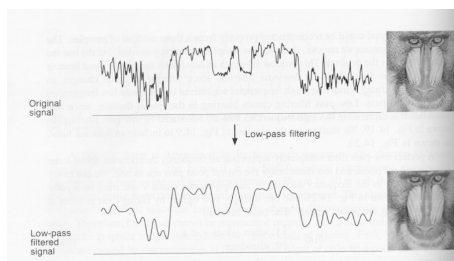
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Aliasing

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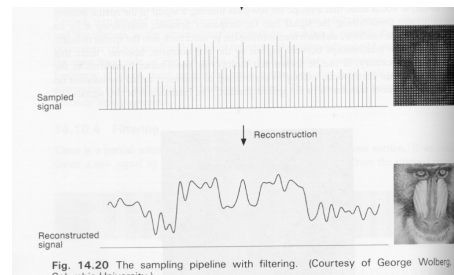
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Low-Pass Filtering



Examples from Foley, van Dam, Feiner, and Hughes 14

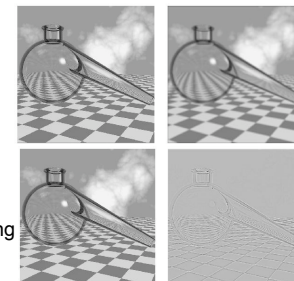
Low-Pass Filtering



Examples from Foley, van Dam, Feiner, and Hughes 15

Filtering

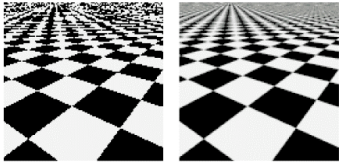
- low pass
 - blur
- high pass
 - edge finding



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Texture Antialiasing

- texture mipmapping: low pass filter



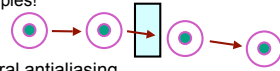
(a)

(b)

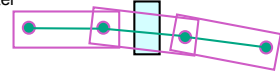
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Temporal Antialiasing

- subtle point: collision detection about algorithms for finding collisions *in time* as much as space
- temporal sampling
 - aliasing: can miss collision completely with point samples!



- temporal antialiasing
 - test line segment representing motion of object center



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Modern Hardware

- use nice slides by Gordon Wetzstein
 - lecture 23 from <http://www.ugrad.cs.ubc.ca/~cs314/Vjan2009/>
 - slides, downloadable demos

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