Adaptive Super Sampling and Multi-Pixel Filtering

Problem Statement

- How can you get the highest quality image with the least amount of samples/ computation?

Solution Research

- Solution 1: Multi-pixel filtering
- Solution 2: Super sampling secondary rays
- Solution 3: Adaptive super sampling

Multi-Pixel Filtering

- Uses neighboring pixels to determine a better color for pixels after sampling the image.
- The goal is to smooth out edges without much additional computational intensity.

Various filters:

Box   Triangle   Gauss   Mitchell   Lanczos
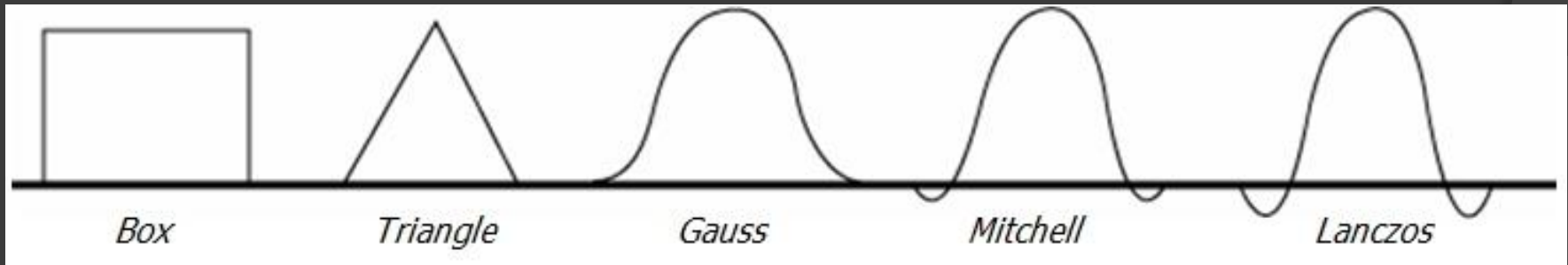
Super Sampling Secondary Rays

- For every primary "visibility" ray sample light sources, reflection, and texture lookup multiple times.

- This improves the quality of shadows, lighting, and texture mapping with fewer primary rays.

Light

Texture lookup
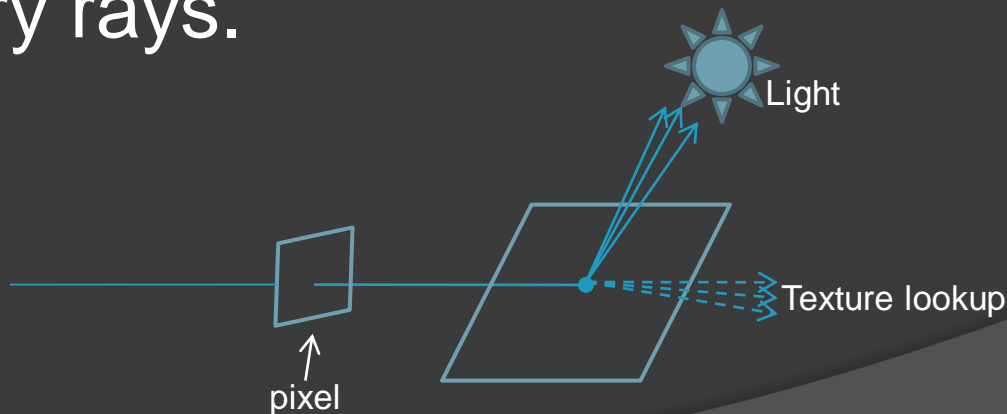
pixel

Adaptive Super Sampling

- The process of taking a small amount of "feeler" rays at the corners of the pixel. If the color varies by too much shoot more rays to try to find a good average color, repeat until a good color is found, or a limit is reached.

- The principle behind this is that only "boundary" pixels need many samples to calculate the color.
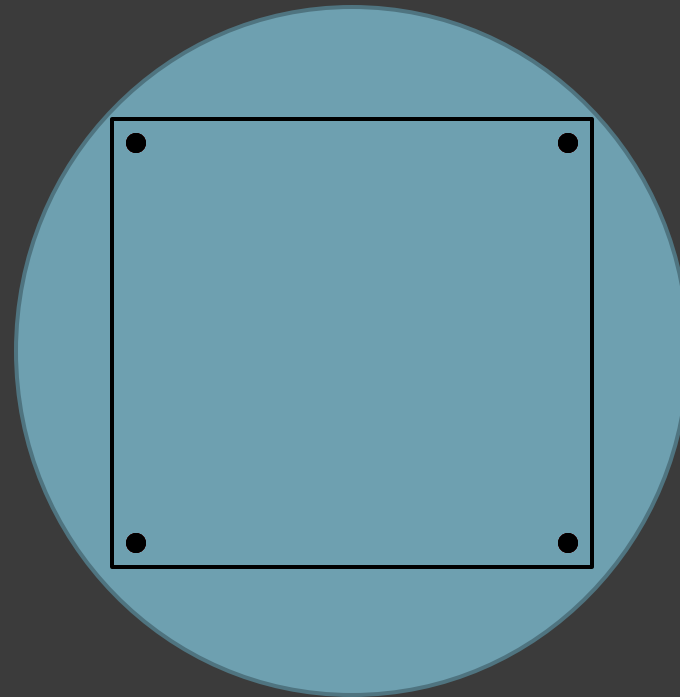
Adaptive Super Sampling Cont.

Example:

Done!
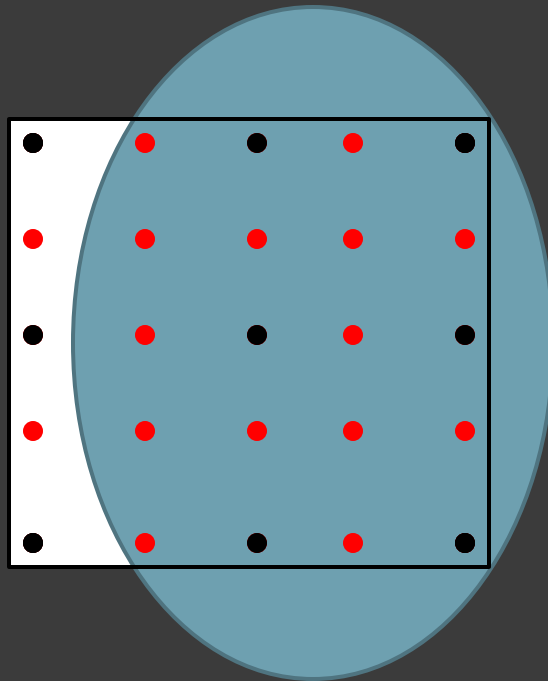
Done!

Color:

Color:

Proposed Solution

- Implement Adaptive Super Sampling as seen in the demonstration. Have a command file option for max number of sampling iterations.

- Implement Multi-Pixel Filtering with a 3x3 box filter.

- Allow the user to specify in the command file if they want extra samples for different domains (texture, light, reflection, etc).

Risk Evaluation

- Time, we may not have enough time to implement all of the above well. We plan on implementing them in the order listed previously, at least finishing Adaptive Super Sampling and Multi-Pixel filtering.

- References for Multi-Pixel Filtering, and Super Sampling Secondary Rays are hard to find.

- We will compare our results in quality of image and render time to MP4 with 4-32 random samples.

References

- Amortized Supersampling
  http://www.cs.virginia.edu/~gfx/pubs/Yang_2009_AMS/yang2009.pdf

- Ray Tracing With Adaptive Supersampling in Object Space.
  http://www.cs.uaf.edu/~genetti/Research/Papers/GI93/GI.html

- Selective and Adaptive Supersampling for Real-Time Ray Tracing
  ftp://grmanet.sogang.ac.kr/pub/ihm/webpapers/09HPG.pdf

- Supersampling.
  http://en.wikipedia.org/wiki/Supersampling