ReSTIR with DirectX Ray Tracer

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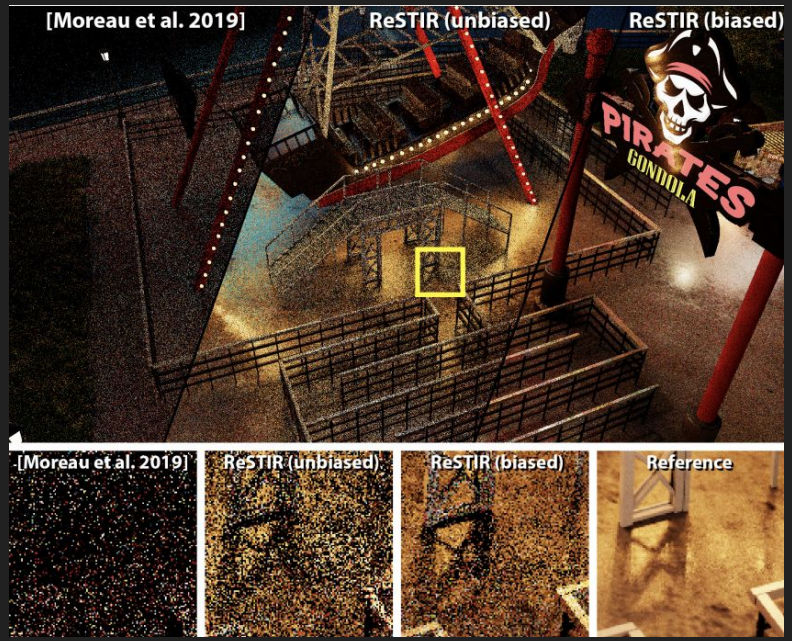
Goal for this milestone

- Implement our ReSTIR knowledge in our DirectX ray tracing code
- Point Lights
- Non-moving frames

Image from Spatiotemporal reservoir resampling for real-time ray tracing with dynamic direct lighting

ReSTIR overview



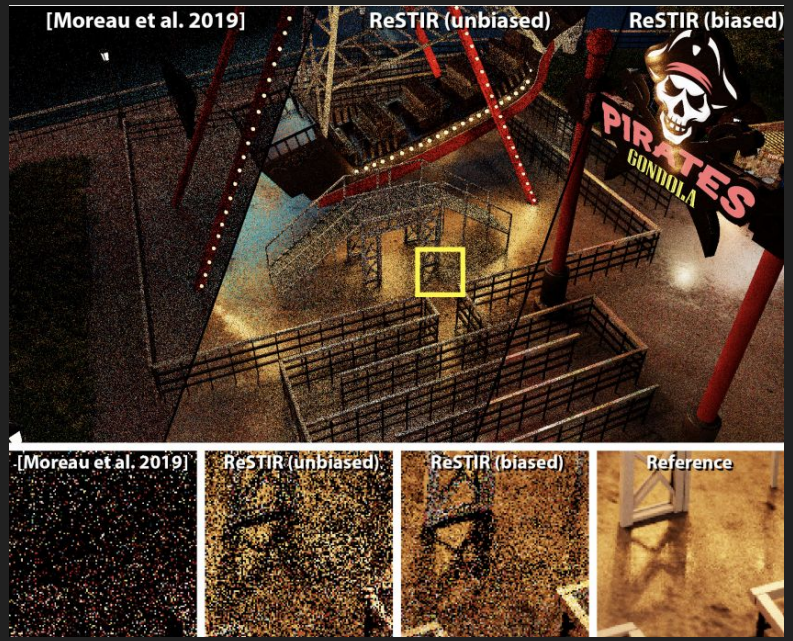
For each pixel:

1. Select 1 light from 32 randomly chosen lights
2. Shoot a shadow ray from the light to pixel. If it is obscured, discard selection
3. Compare the light used in the last iteration to the light from step 2. Choose one
4. Compare the lights from random adjacent pixels to one from step 3. Choose one.
5. Shoot a shadow ray to light from step 4 and shade pixel.

Use a combination of Weighted Reservoir Sampling (WRS) and Resampled Importance Sampling (RIS) to select and compare lights.

Image from Spatiotemporal reservoir resampling for real-time ray tracing with dynamic direct lighting

ReSTIR overview



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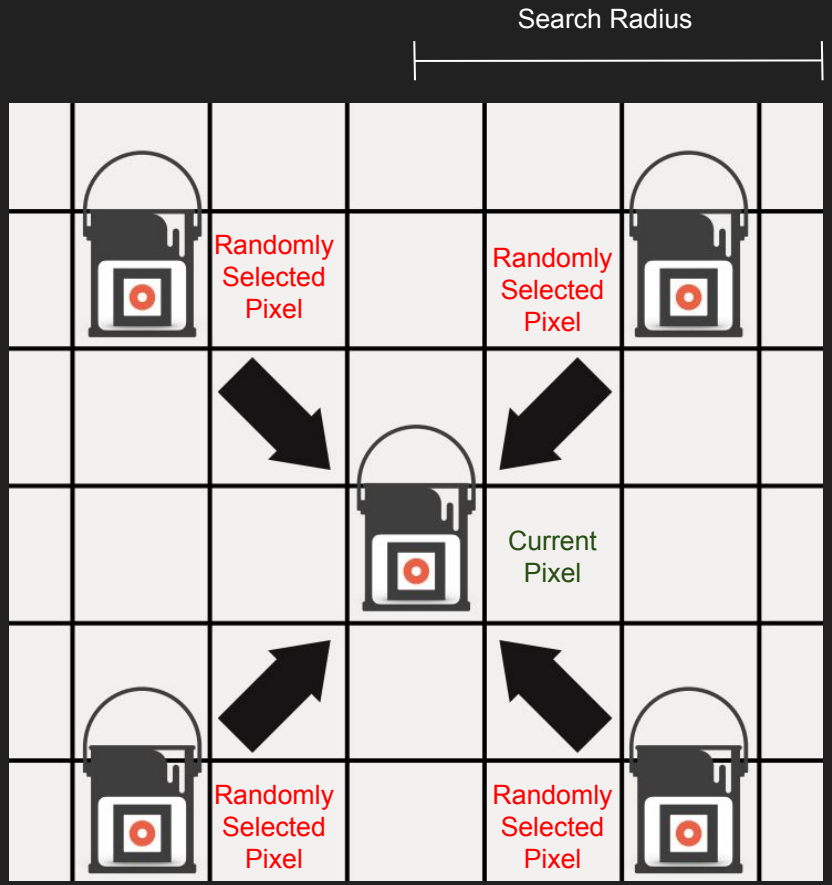
Spatial Reuse Explanation

- Sample k = 5 random points in a 10 - pixel radius around the current pixel
- Compute the weight at each of the selected neighbors multiplying:
  - Lambert term / pdf
  - Reservoir weight
  - Candidates the reservoir has seen so far
- Combine the reservoirs and Update the current pixel.

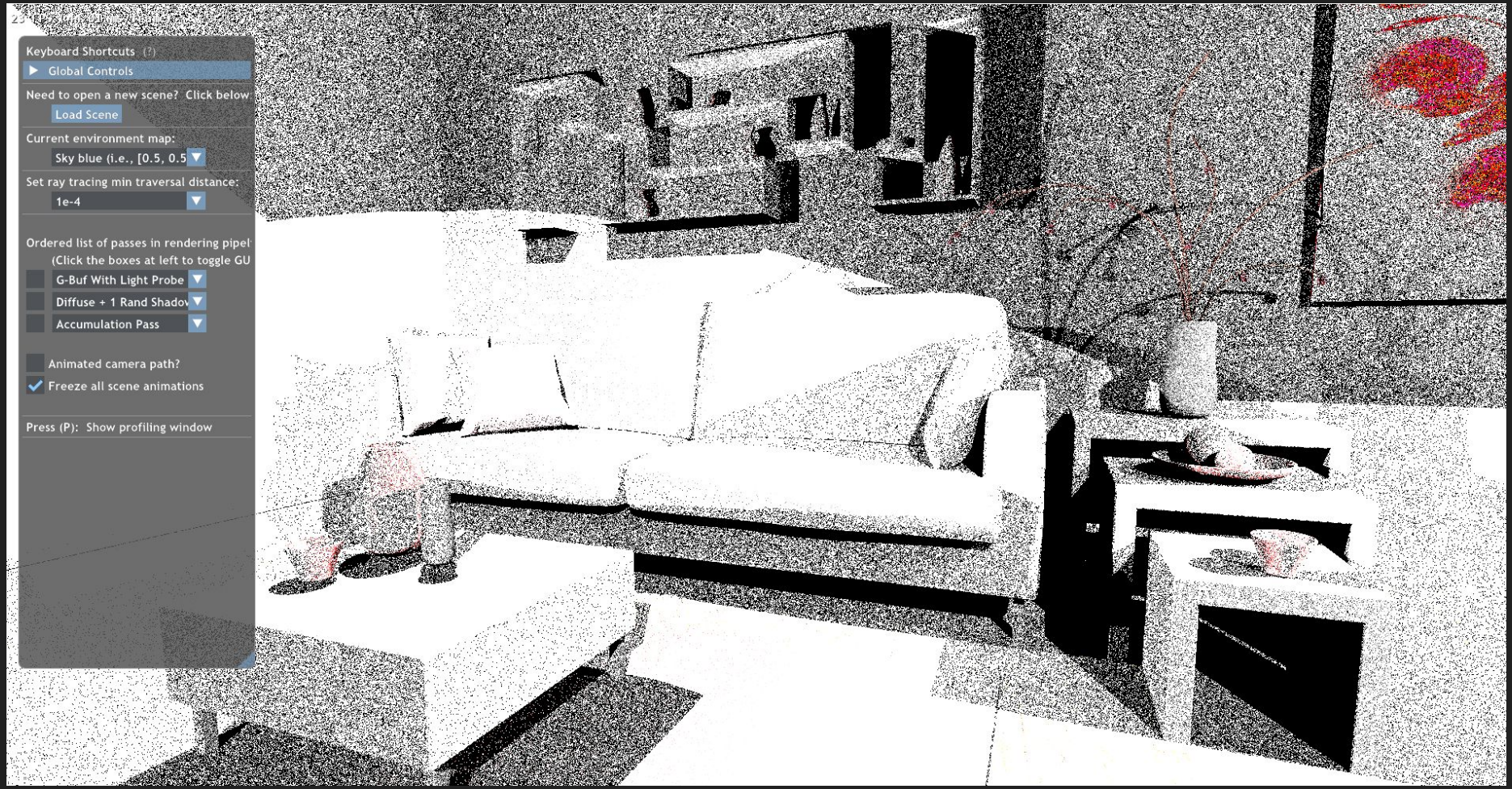


Ground truth (multiple frames)

Base Code (first frame) (select one random light)

ReSTIR (first frame) (no spatial or temporal reuse)

Bloopers


Keyboard Shortcuts (?)
Global Controls
Need to open a new scene? Click below:
Load Scene
Current environment map:
Sky blue (i.e., [0.5, 0.5
Set ray tracing min traversal distance:
1e-4
Ordered list of passes in rendering pipel
(Click the boxes at left to toggle GU
G-Buf With Light Probe
Diffuse + 1 Rand Shadov
Accumulation Pass
Animated camera path?
Freeze all scene animations
Press (P): Show profiling window

Challenges

Deciding on best implementation for reservoirs

- Randomly choosing light candidates could potentially repeat candidates
- If statements decrease efficiency in shaders (best format for DirectX)

Weighting Neighboring Pixels

- Using ping pong buffers to avoid reading and writing to the same buffers at a time.
- Initially had trouble understanding how to include neighboring reservoirs to weight a pixel.
- Discovered some helper functions and buffers to access light and pixel data easily across shaders.

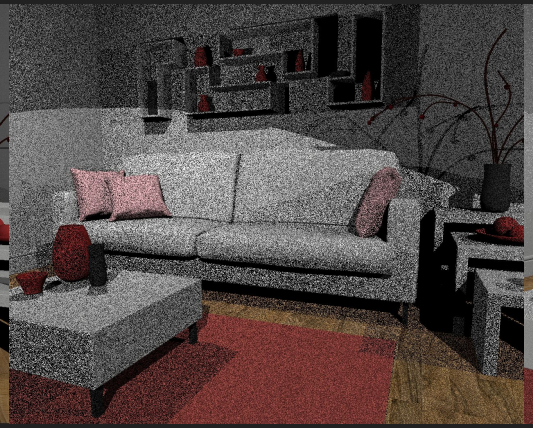
Goal for the next milestone

- Complete spatial reuse
- Temporal reuse (Using previous frames in an animation)
- Incorporate global illumination

Ground Truth

Base Code

One Iteration with direct lighting using one random light



Our Code

One Iteration using ReSTIR algorithm to select one light