DXR Photon Mapper

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Acknowledgement

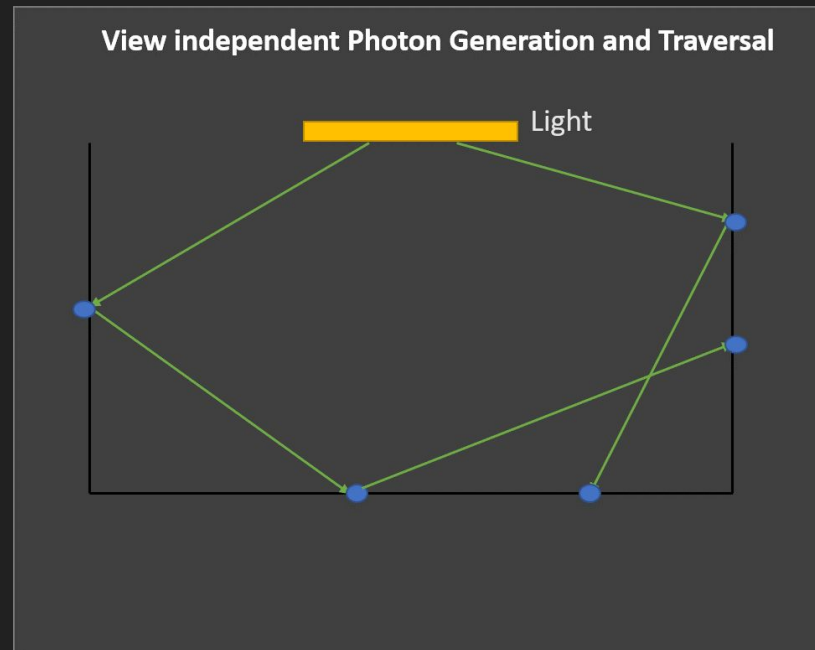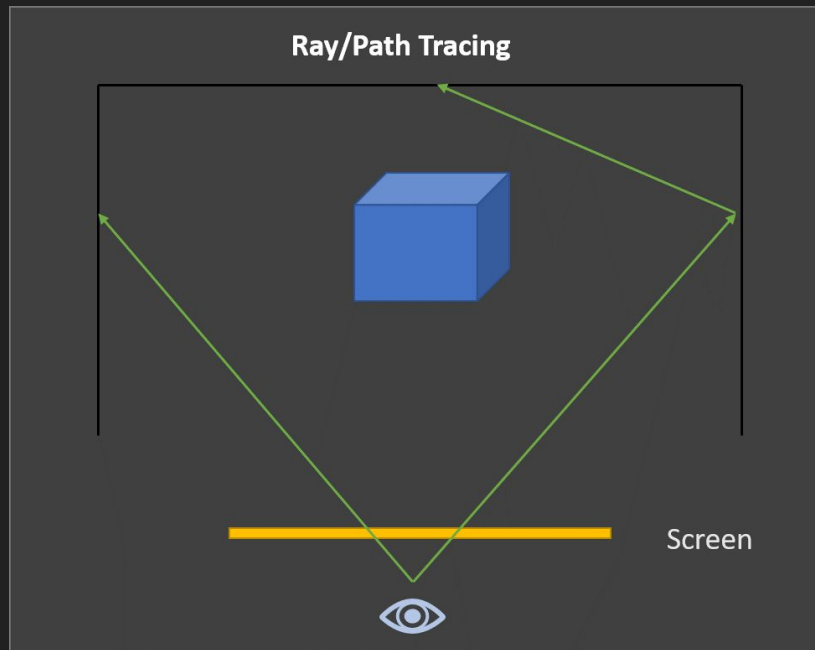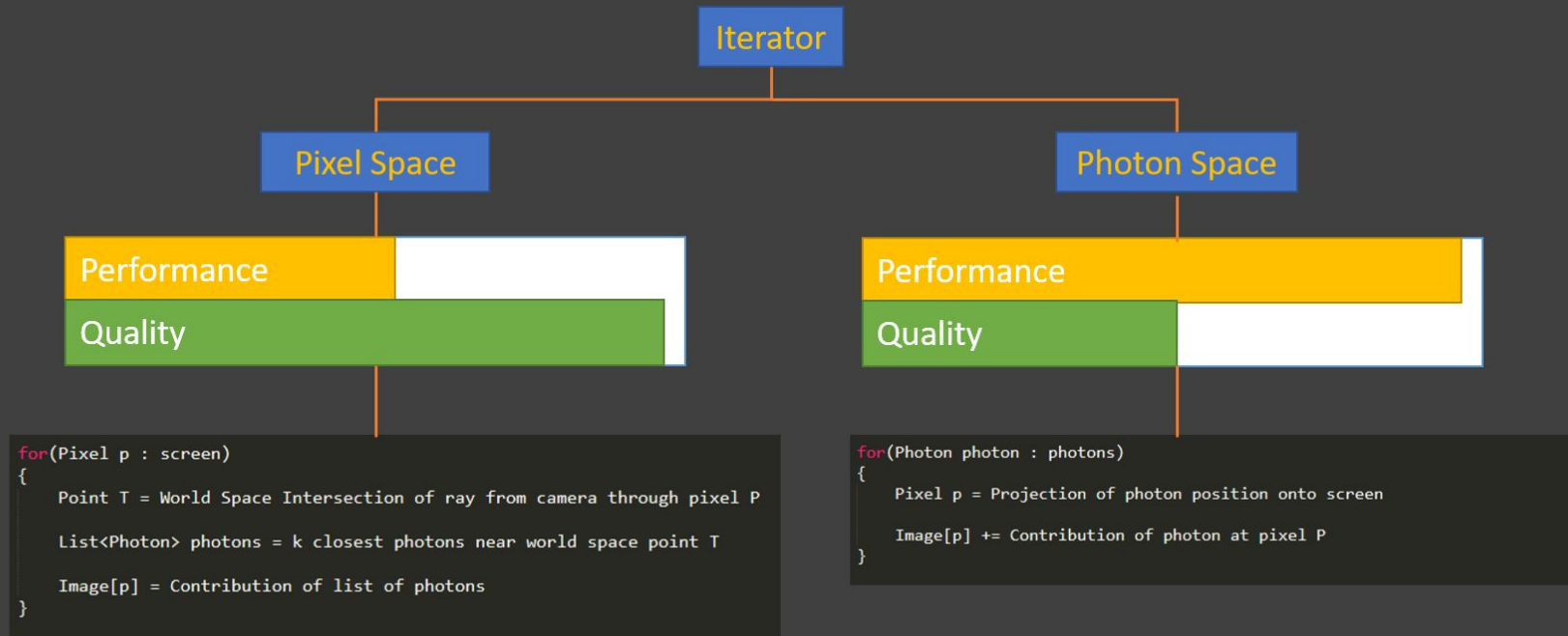# Goals of the project

❖ ***Implementation of Photon Mapping using DXR***

❖ ***Possible search time optimizations***

❖ ***Alternate approaches to spatial data structure construction***
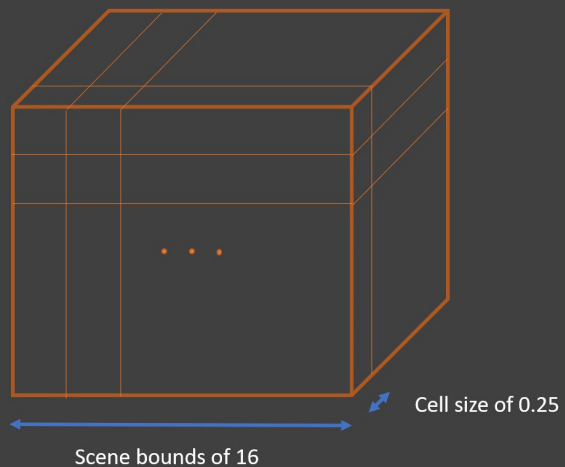
Ray Tracing vs Photon Mapping

Pixel Major vs Photon Major Iterator


```
for(Pixel p : screen)
{
    Point T = World Space Intersection of ray from camera through pixel P

    List<Photon> photons = k closest photons near world space point T

    Image[p] = Contribution of list of photons
}
```

```
for(Photon photon : photons)
{
    Pixel p = Projection of photon position onto screen

    Image[p] += Contribution of photon at pixel P
}
```

Pixel Major Iterator

Scene Division into cell structure

Cell size of 0.25

Scene bounds of 16

Customization of photon storage

Photon Count per cell

2	0	1	3	5	• • •

Exclusive Scan on Count – Starting index for sorted photons

0	2	2	3	6	• • •

Photon Map

P1	P2	P3	P4	P5	• • •

Photon Major Iterator

View independent Photon Generation and Traversal

Light

Shadow Ray Culling

Camera

Screen

Photon

Photon

Pixel Major Results

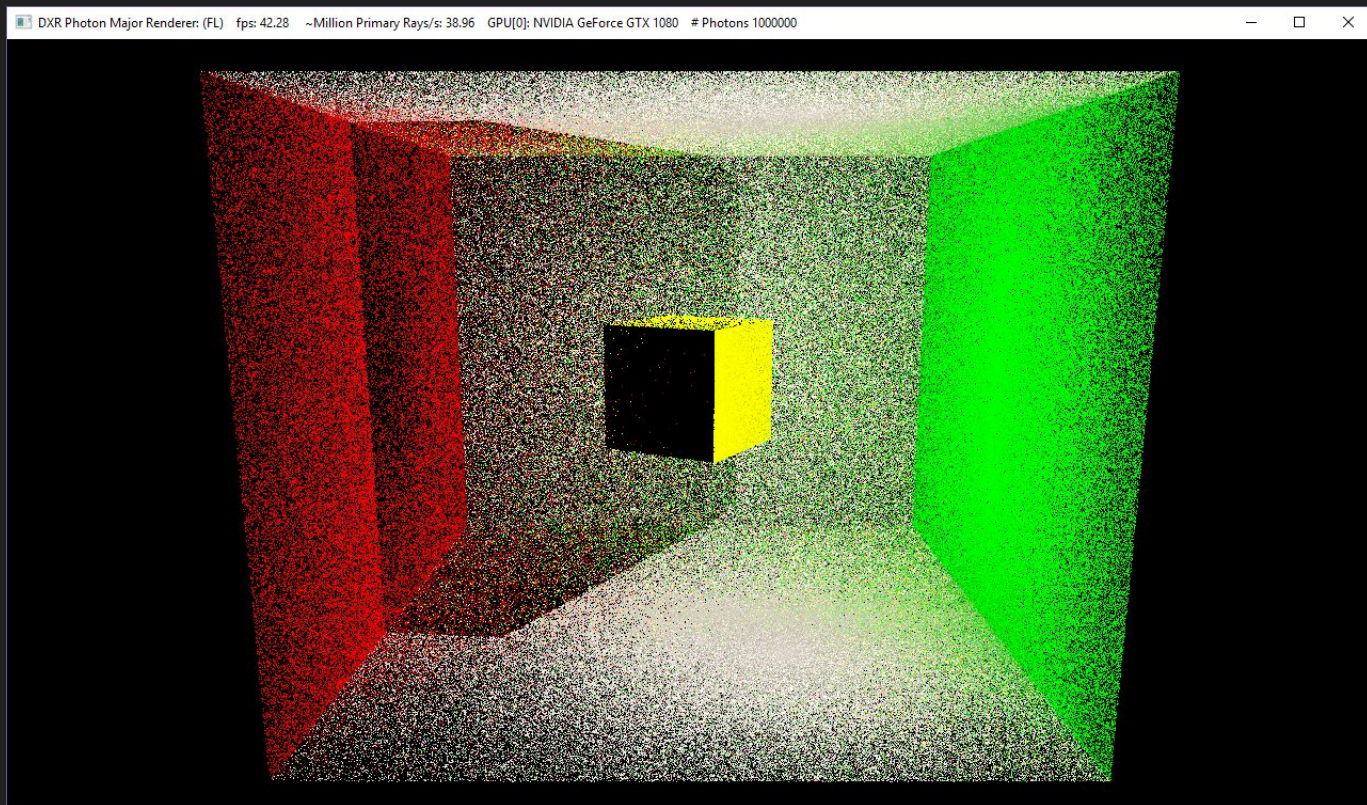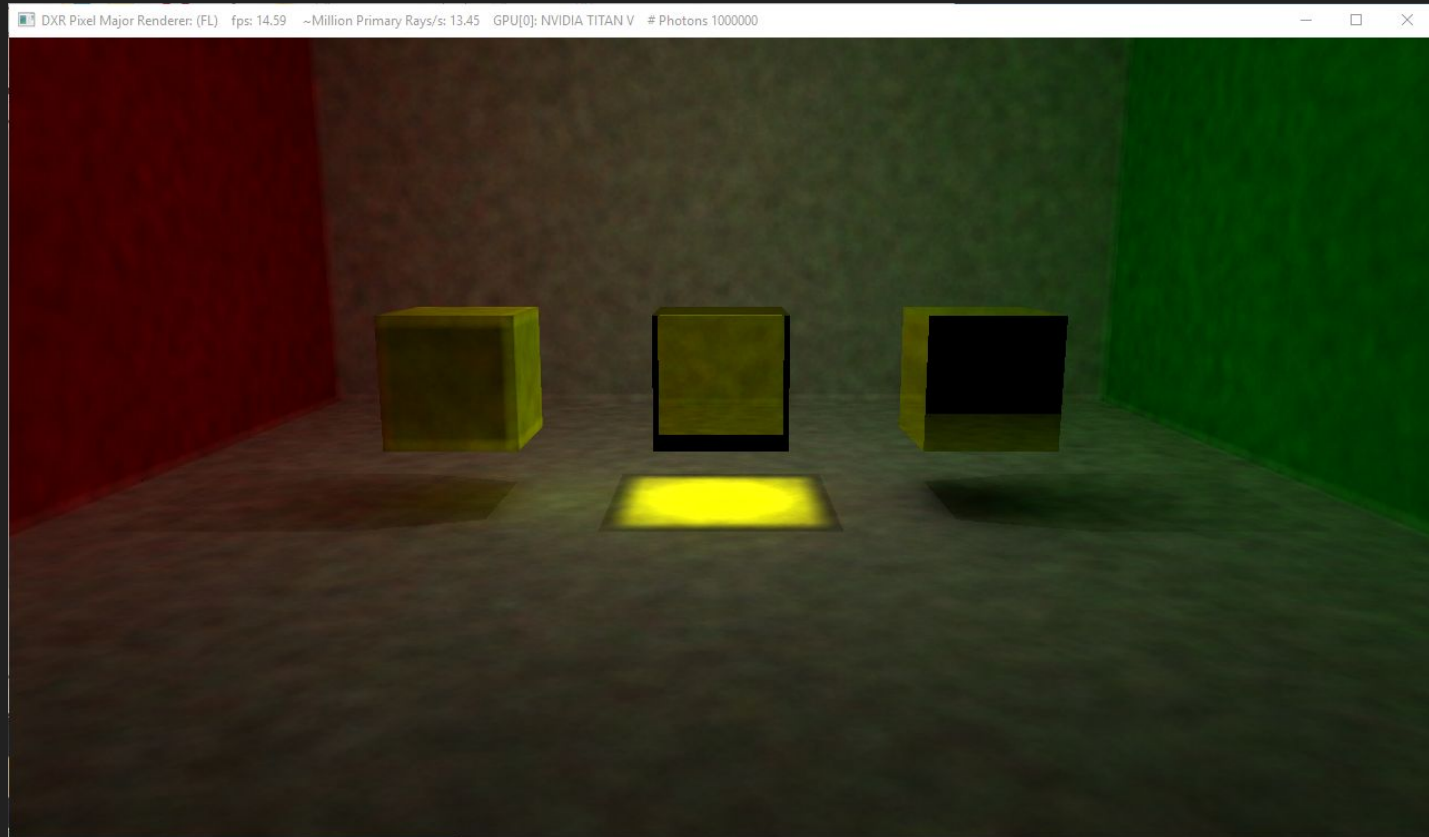DXR Pixel Major Renderer: (FL)   fps: 10.00   ~Million Primary Rays/s: 9.22   GPU[0]: NVIDIA TITAN V   # Photons 1000000
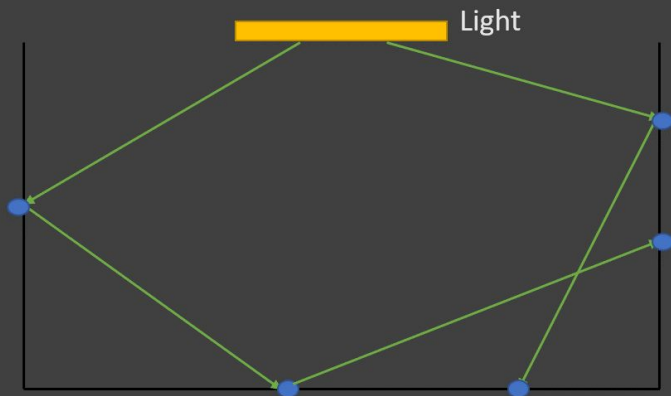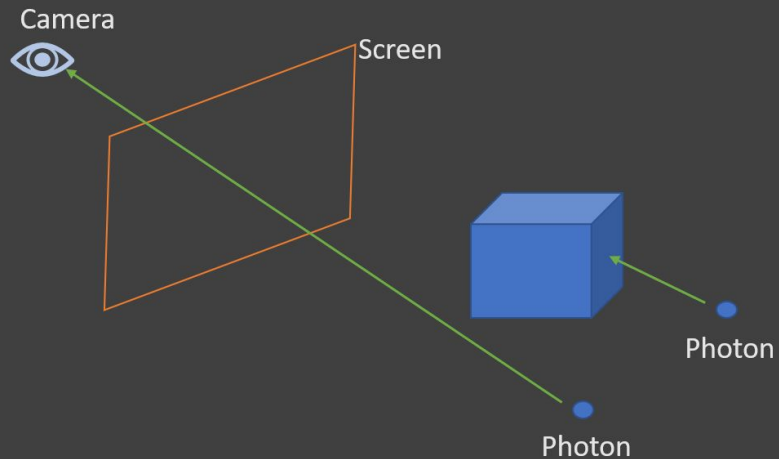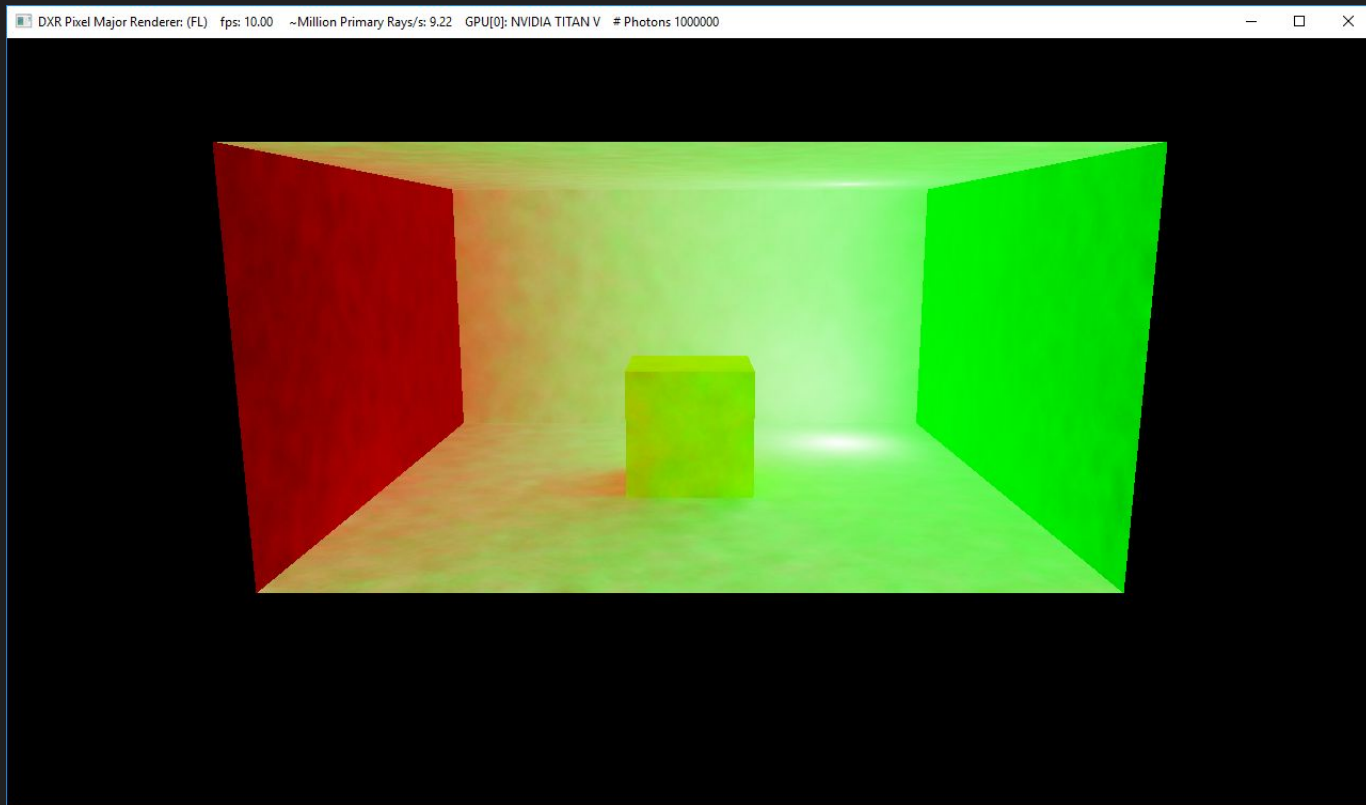
Photon Major Iterator results

Perfectly Specular materials

Performance Analysis - Pixel Major Naive

Performance of Naïve Search
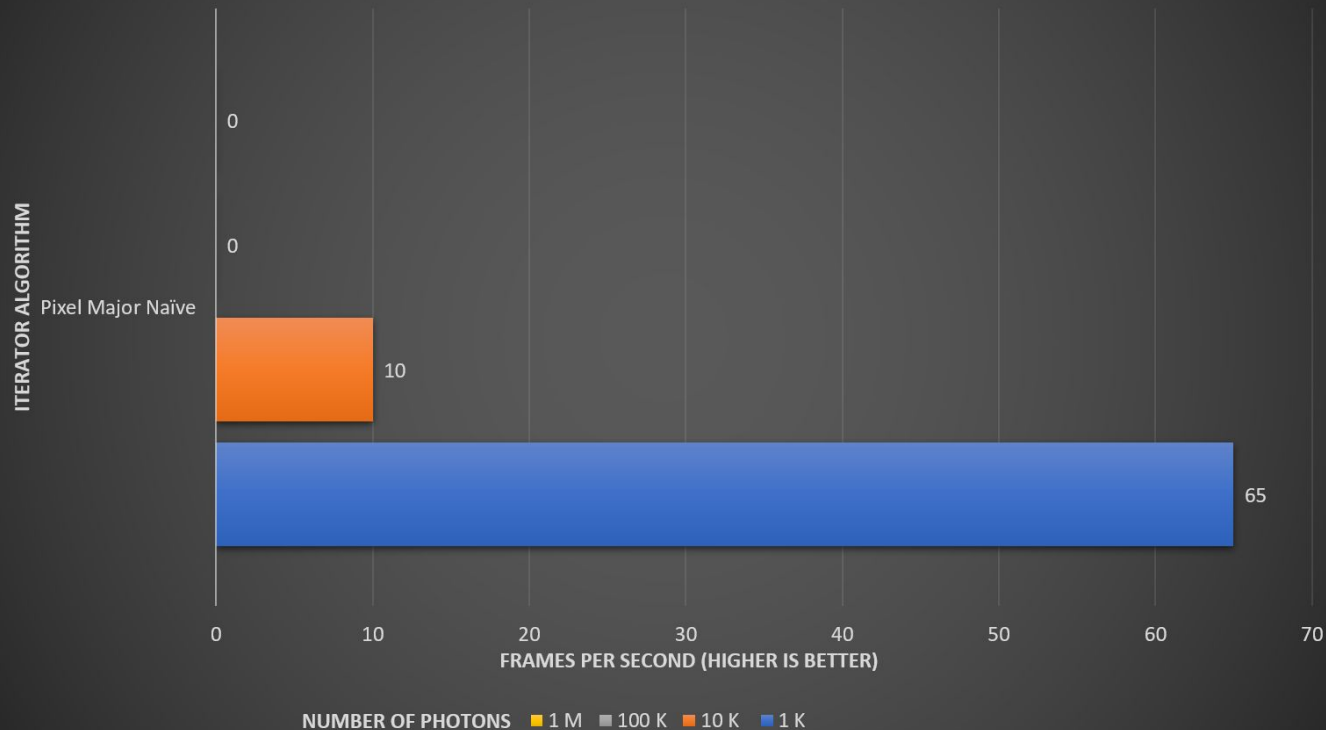
ITERATOR ALGORITHM

Pixel Major Naïve — 0, 0, 10, 65

FRAMES PER SECOND (HIGHER IS BETTER)

0   10   20   30   40   50   60   70

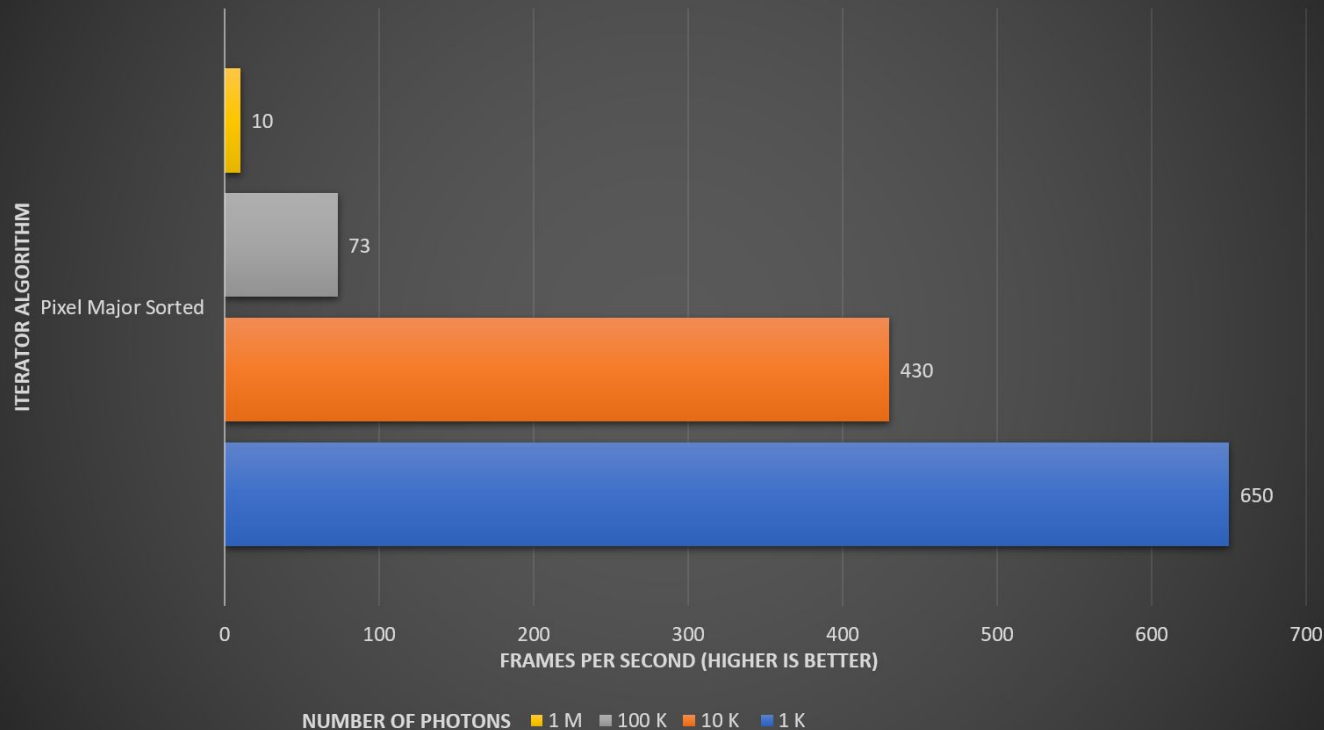NUMBER OF PHOTONS: ■ 1 M   ■ 100 K   ■ 10 K   ■ 1 K

Test Conditions

- NVIDIA Titan X
- DirectX Fallback Layer
- V-Sync Off
- 8 Bounces per Photon

Performance Analysis - Pixel Major Sorted

Performance Pixel Major – Sorted Photons

ITERATOR ALGORITHM

Pixel Major Sorted
- 1 M: 10
- 100 K: 73
- 10 K: 430
- 1 K: 650

FRAMES PER SECOND (HIGHER IS BETTER)

0   100   200   300   400   500   600   700

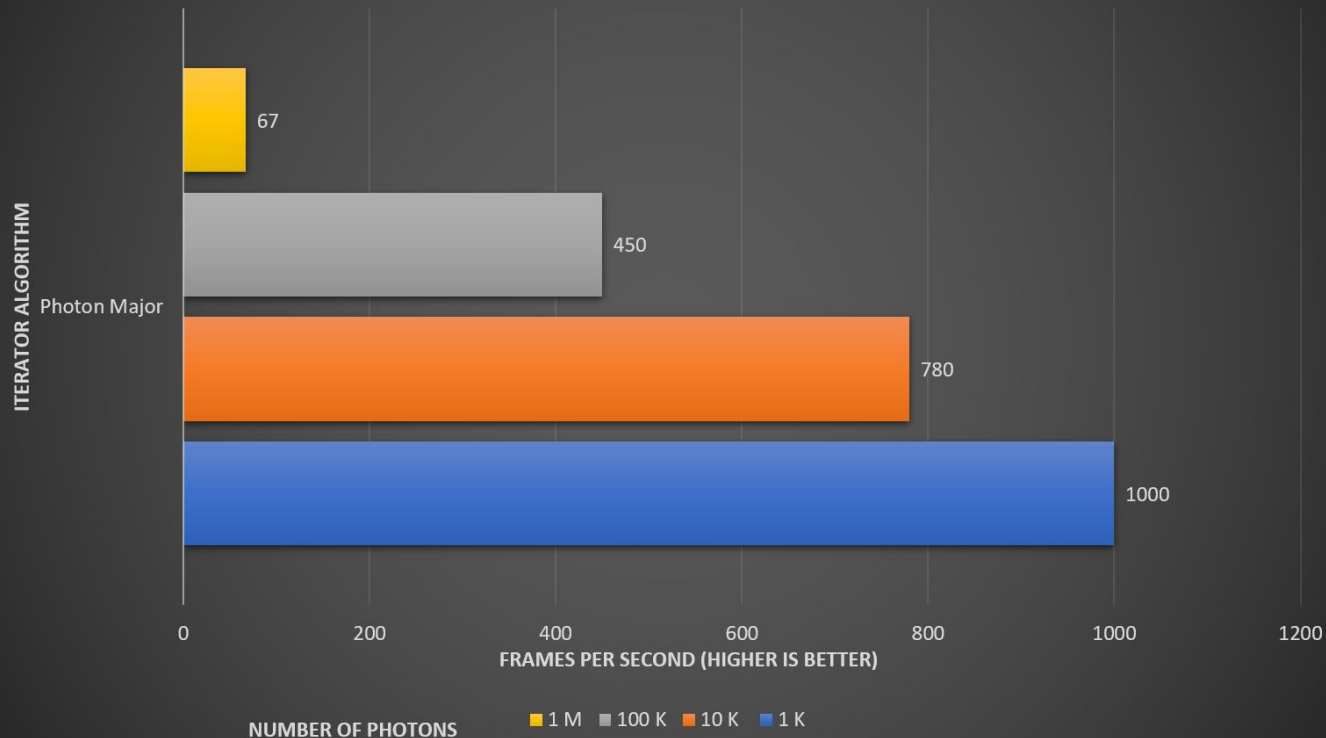**NUMBER OF PHOTONS** ■ 1 M ■ 100 K ■ 10 K ■ 1 K

Test Conditions

- NVIDIA Titan X
- DirectX Fallback Layer
- V-Sync Off
- 8 Bounces per Photon

Performance Analysis - Photon Major

Performance of Photon Major Iterator

Chart axis labels:
- ITERATOR ALGORITHM (vertical axis)
- Photon Major
- FRAMES PER SECOND (HIGHER IS BETTER) (horizontal axis)
- NUMBER OF PHOTONS

Bar values: 67, 450, 780, 1000

Legend (NUMBER OF PHOTONS): 1 M | 100 K | 10 K | 1 K

Test Conditions

- NVIDIA Titan X
- DirectX Fallback Layer
- V-Sync Off
- 8 Bounces per Photon

Possible Future research?

1) Improve sorting and searching of photon -
   a) Better Memory Management
   b) Faster search
2) Denoising in Photon Major

Questions?