

Dynamic Diffuse Global Illumination in Mini Minecraft

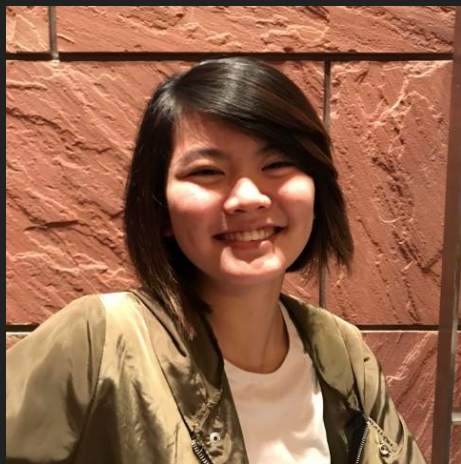
Helen Liu, Janine Liu, Spencer Webster-Bass



Introductions



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CGGT Masters Student



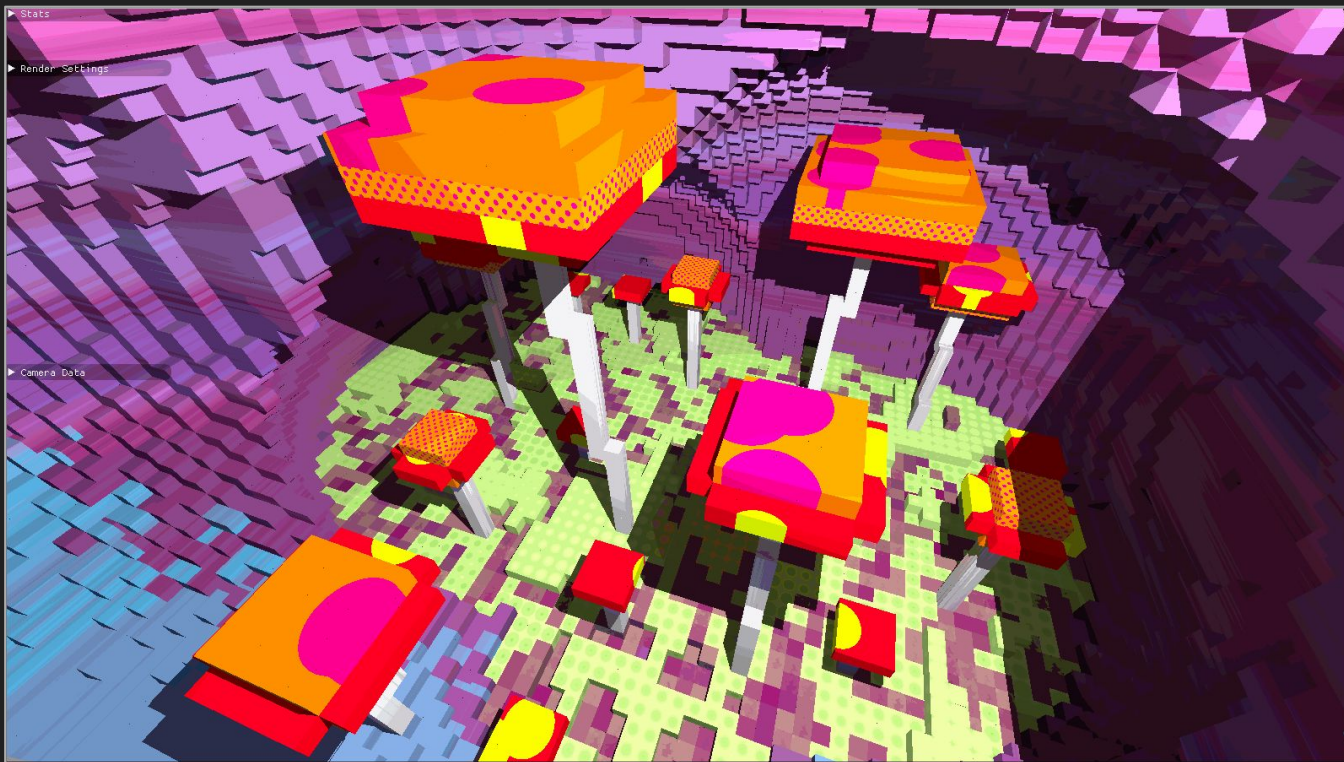
Janine Liu
DMD Senior



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DMD Senior

Goal

Using the Vulkan API, this project aims to generate a dynamic Minecraft-inspired scene illuminated by Dynamic Diffuse Global Illumination (DDGI) Probes as described in [Majercik et. al. \(2019\)](#)

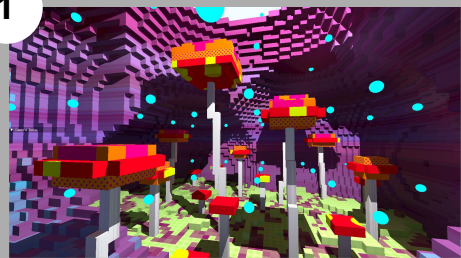


9 x 7 x 9 probe cage | probe distance of 11 | 400 rays per probe | origin of (1.4, 0, 1.0) | Single static light | 5 max bounces

Technical Approach

(per frame)

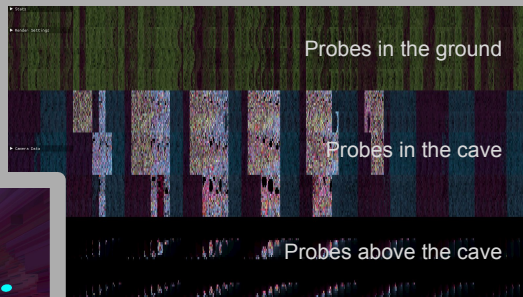
1



Disperse probes
through the scene

2

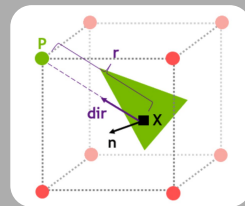
Probe Compute Pass



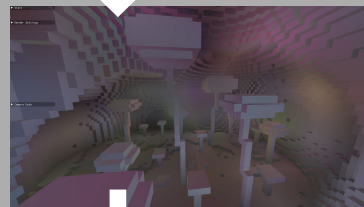
Update probe textures with
lighting information

3

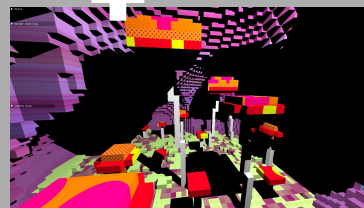
Raytrace Compute Pass



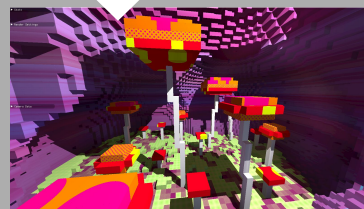
Find and weight
8 closest probes for
Indirect lighting



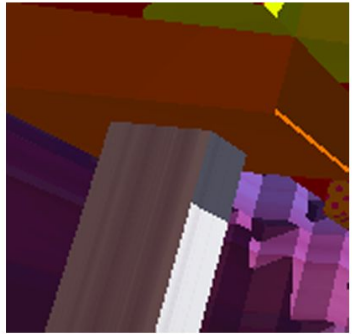
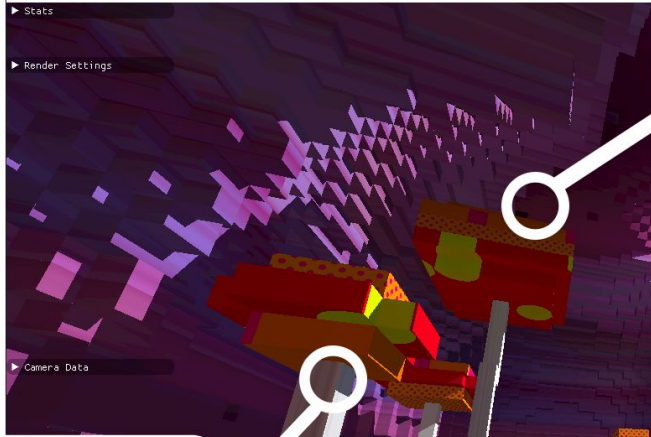
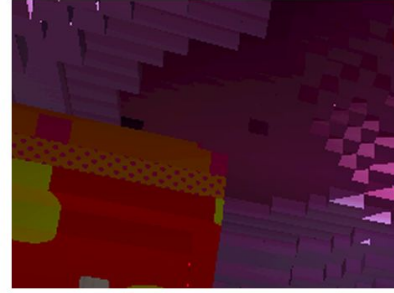
Combine indirect +
direct illumination



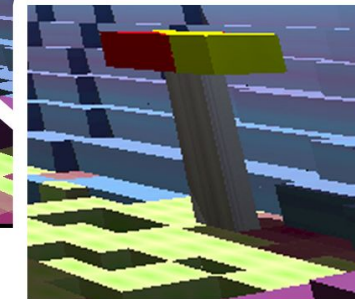
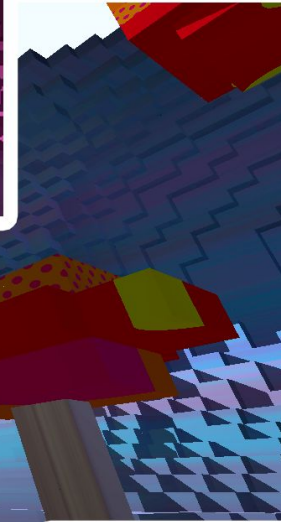
Combined
DDGI Result



Red Illumination from
Mushroom on Ceiling



Blue reflected on stem from cave wall.
Purple-orange stem reflected from cave
wall and mushroom top.

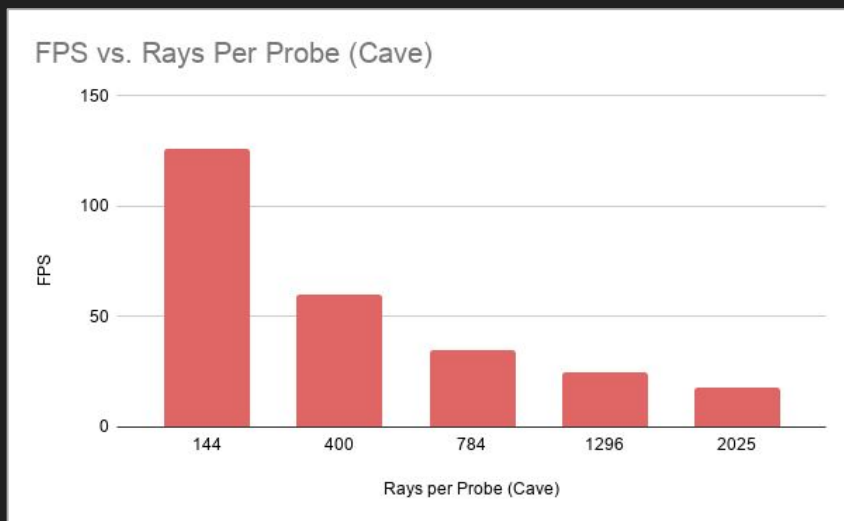


Green & Blue reflected on different
sides of mushroom stem

Demo

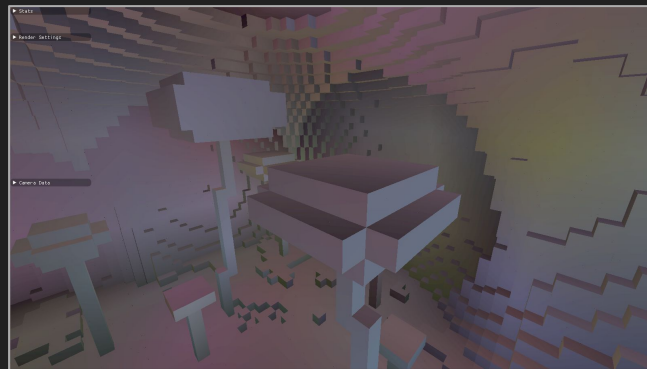
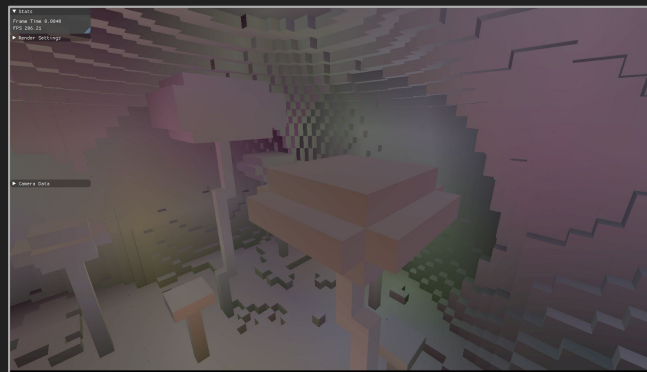


Performance Analysis



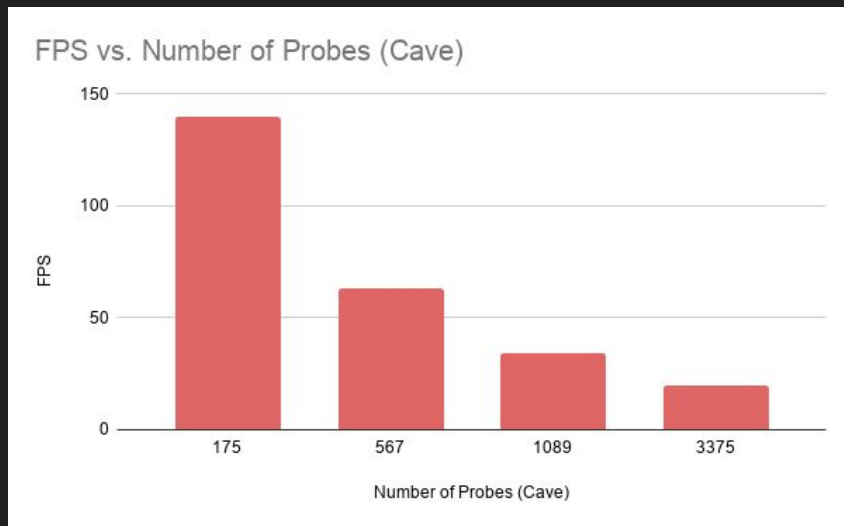
Figures & Images tested with 9 x 7 x 9 probe cage with probe distance of 11
5 bounces | 1 static light
GeForce RTX 2070 8192 MB

16 rays per probe



1600 rays per probe

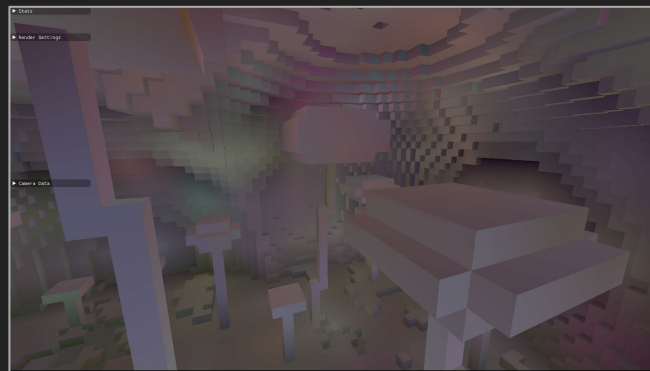
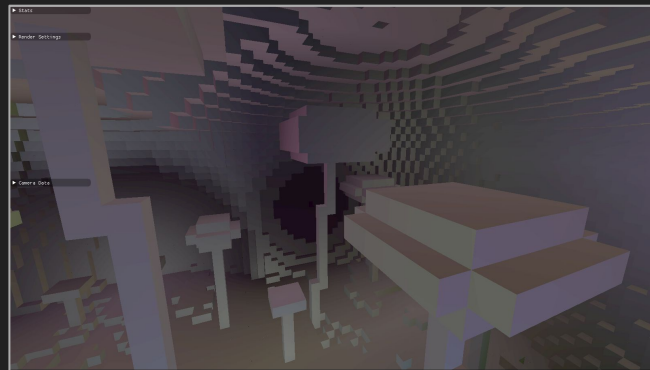
Performance Analysis (cont.)



Figures & Images tested with 400 rays per probe | 5 bounces | 1 static light
Probe distance and dimensions varied
GeForce RTX 2070 8192 MB

Recommended: 9 x 7 x 9 probe cage | probe distance of 11
400 rays per probe | origin of (1.4, 0, 1.0)

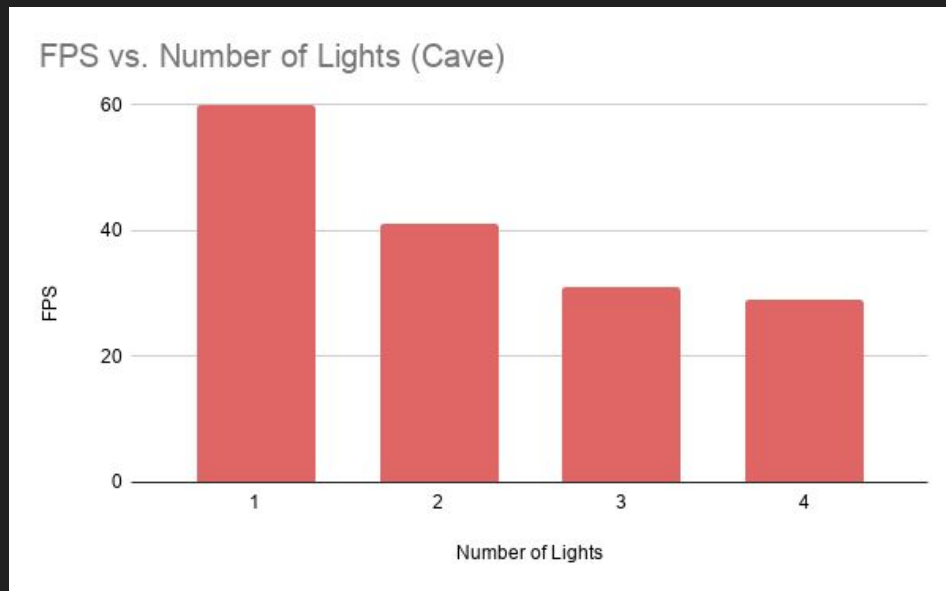
175 probes



3375 probes

Shortcomings & Future Improvements

- Quality of global illumination relies on probe placement
- Performance drops with additional lights
- Performance correlates with texture size



Tested on 9 x 7 x 9 probe cage with probe distance of 11
400 rays per probe | 5 bounces
GeForce RTX 2070 8192 MB

References & Acknowledgments

Special thanks to our Shadow Team: Gizem Dal, Dayu Li, Tushar Purang

- Realtime Vulkan Pathtracer base code:
<https://github.com/GraphicsProgramming/RVPT/>
- Dynamic Diffuse Global Illumination with Ray-Traced Irradiance Fields
research paper: <http://jcgt.org/published/0008/02/01/paper-lowres.pdf>
- Physically-Based Rendering textbook: <http://www.pbr-book.org/>

Thank you!

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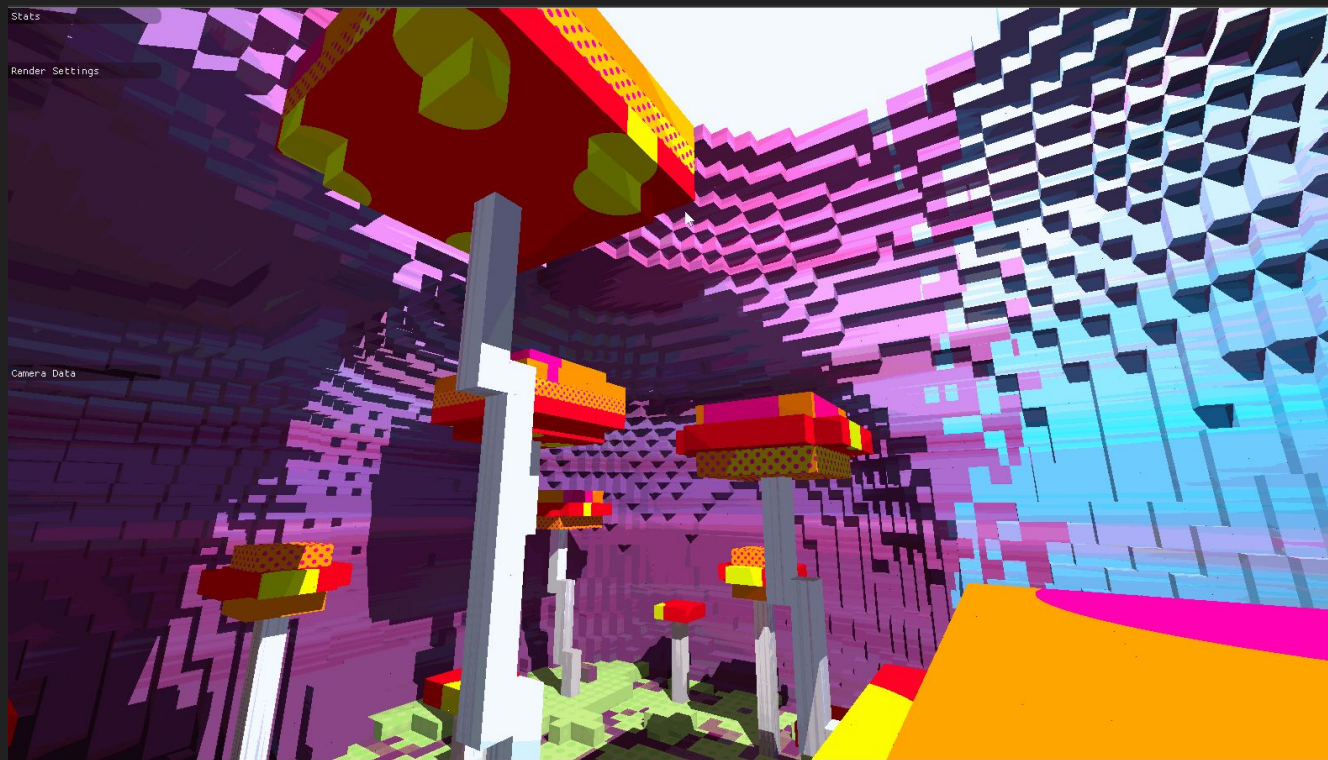
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9 x 7 x 9 probe cage | probe distance of 11 | 400 rays per probe | origin of (1.4, 0, 1.0) | Single Dynamic Light | 5 max bounces