A Comparison of Path Tracing based Sampling Strategies for Global Illumination Methods

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CONTENTS

01

PART ONE

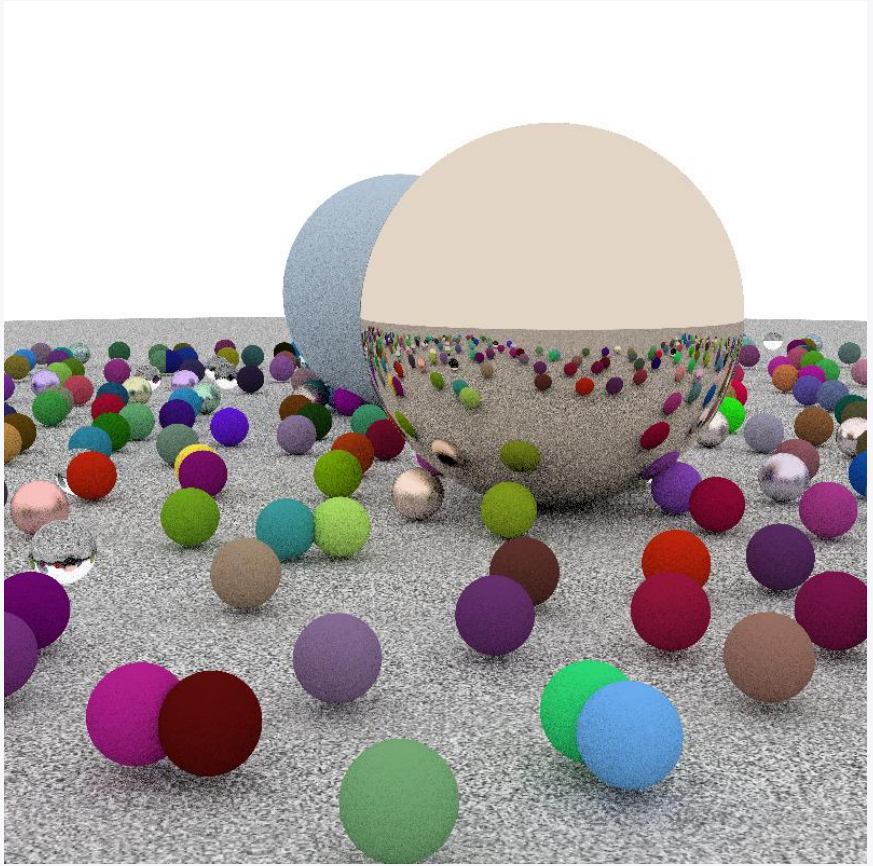
Introduction

- Ray Tracing
- Problem
- Research Question

Ray Tracing

Ray Tracing

> a **rendering** technique for generating an image by **tracing the light** as pixels in an image plane and **simulating the effects** of its encounters with virtual objects.



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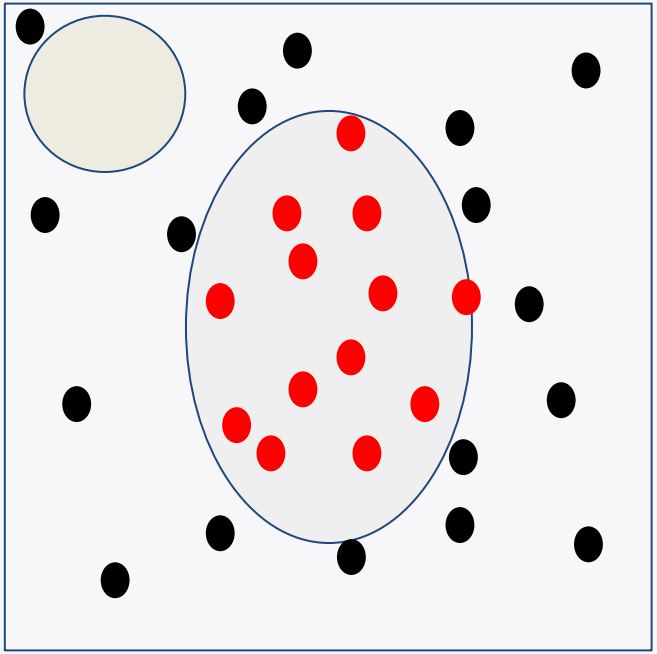
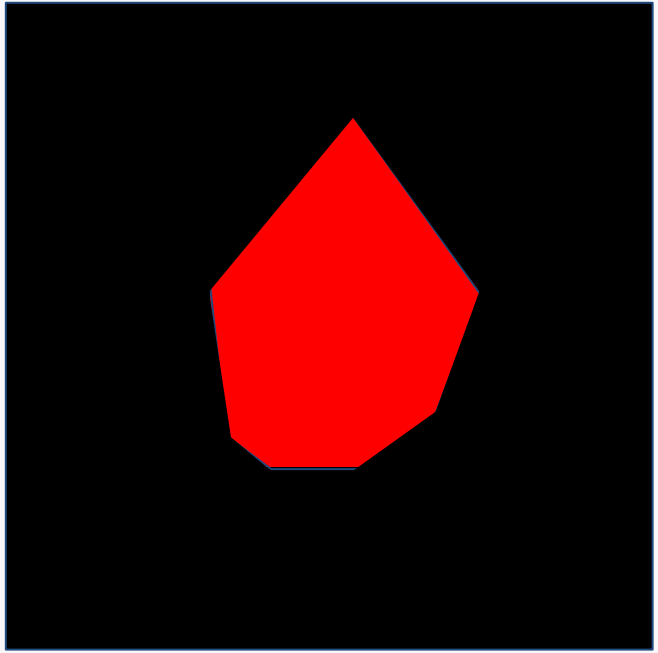
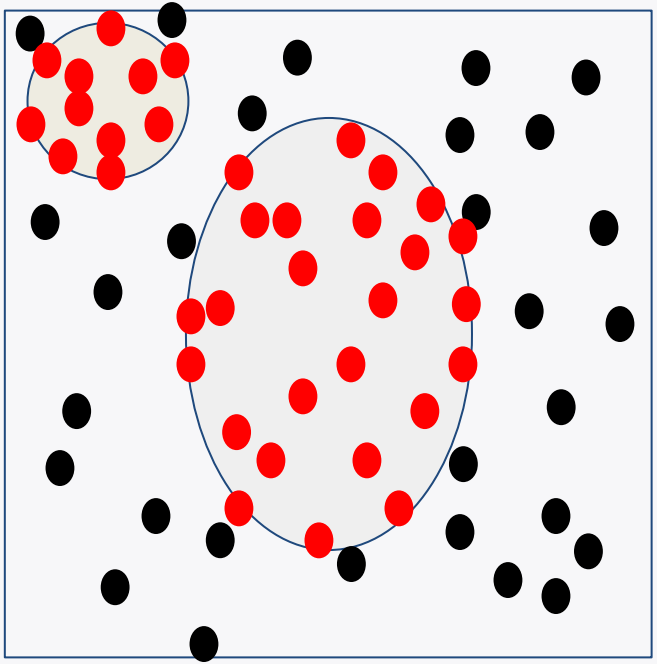
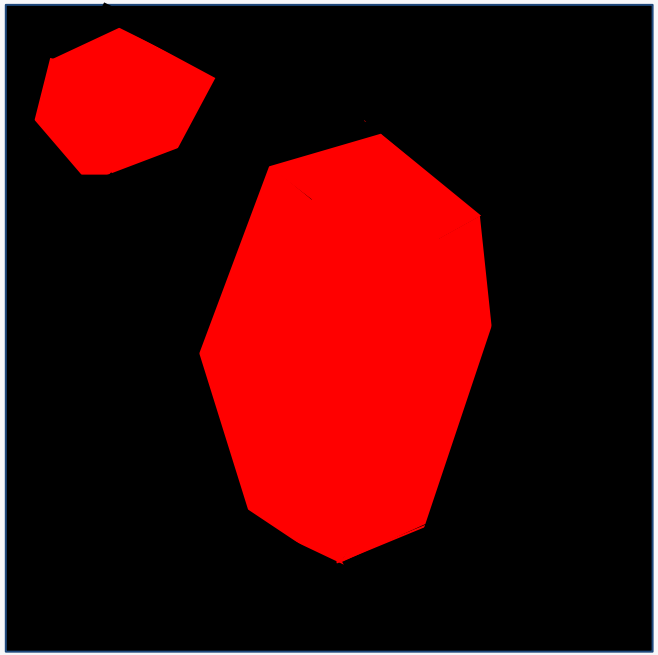


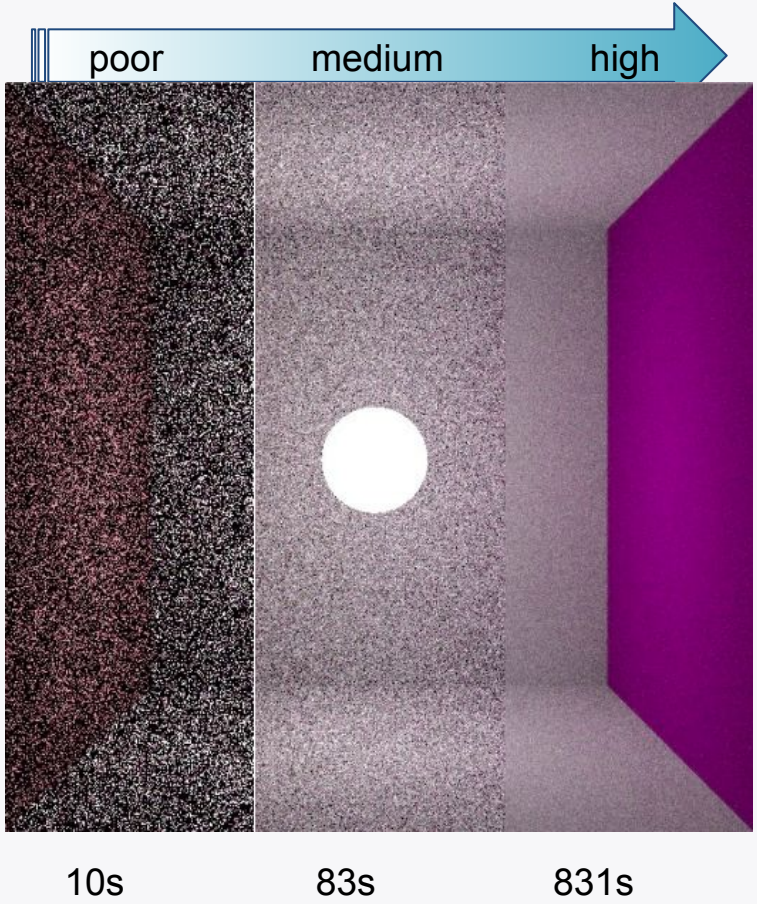


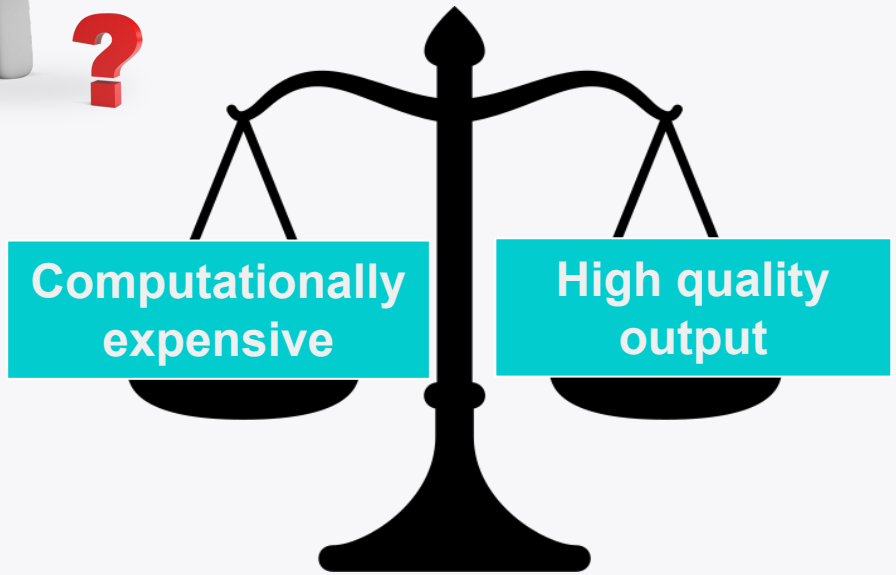
Problem



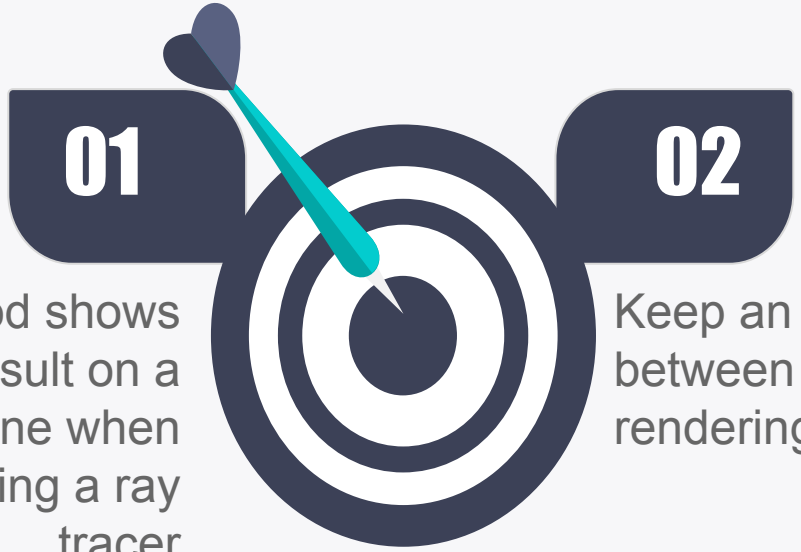


Problem


poor
medium
high
10s
83s
831s


Computationally expensive
High quality output

Research Question



01 Which method shows better result on a specific scene when implementing a ray tracer

02 Keep an optimized balance between quality and rendering time

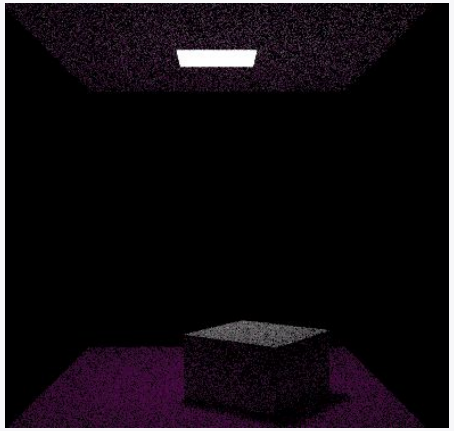
02

PART TWO

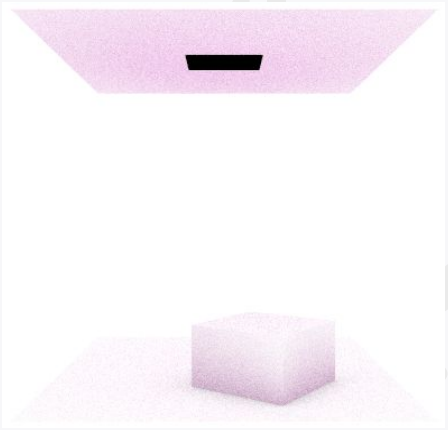
Background

- Illumination
- Path Tracing
- Bidirectional Path Tracing
- Next Event Estimation
- Energy Redistribution Path Tracing

Illumination

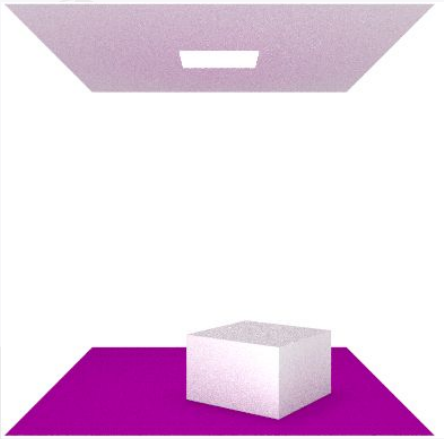


Direct Illumination



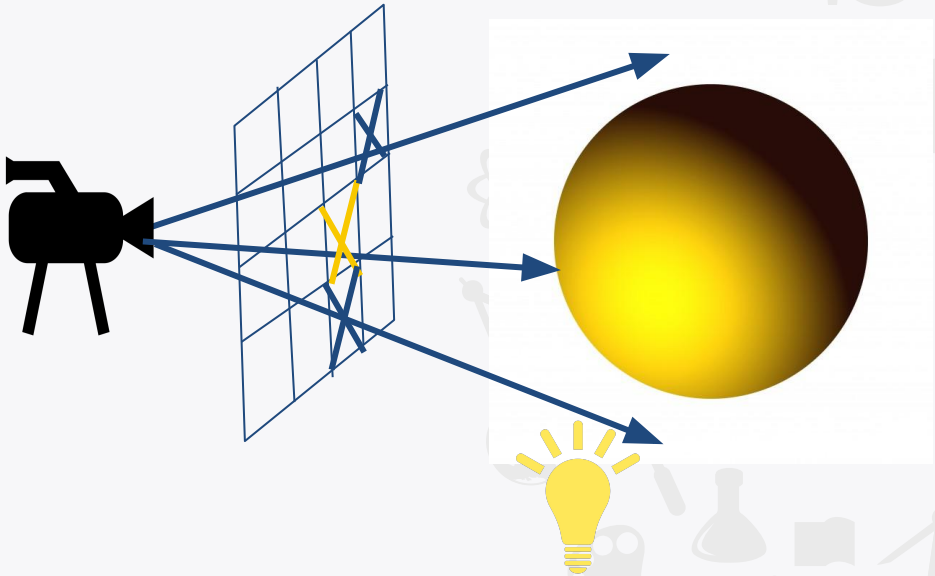
Indirect Illumination

Global Illumination



Path Tracing in the world

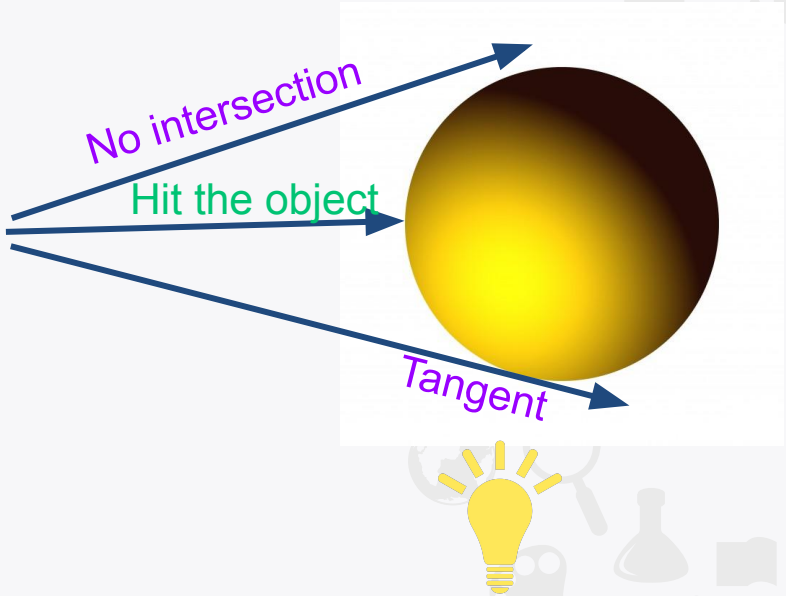
Path Tracing



Shoot rays

Shooting rays
from camera to pixels

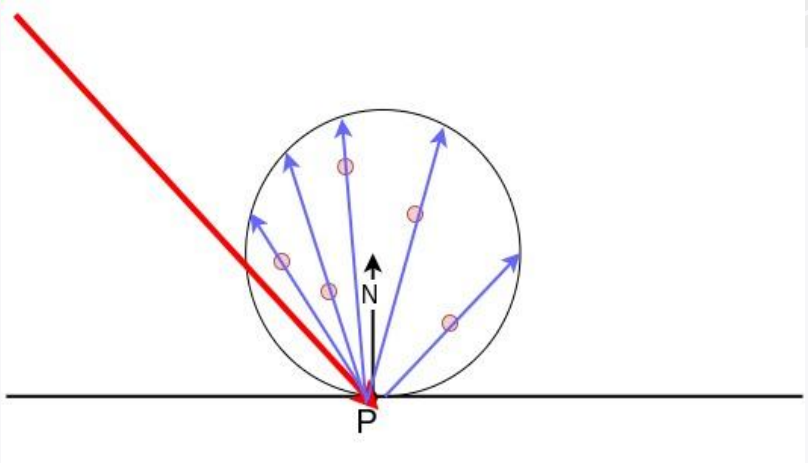
Path Tracing



Intersection

Check if the ray hit the object

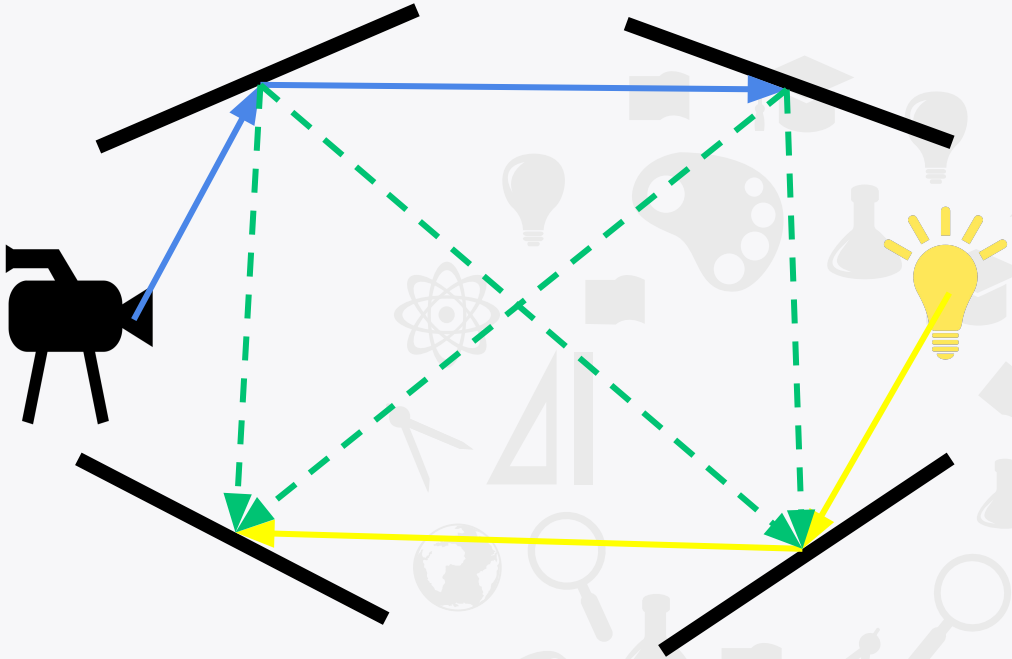
Path Tracing



Path

Create a reflection path

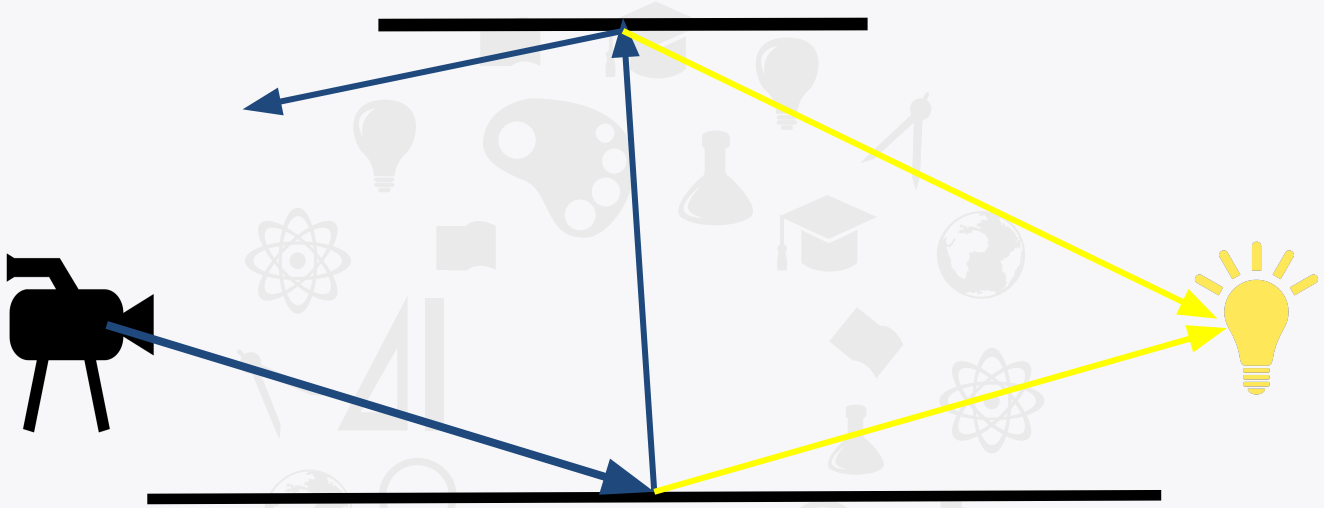
Bidirectional Path Tracing



Camera Path

Light Path

Next Event Estimation



Actual Path

Direct Light Path

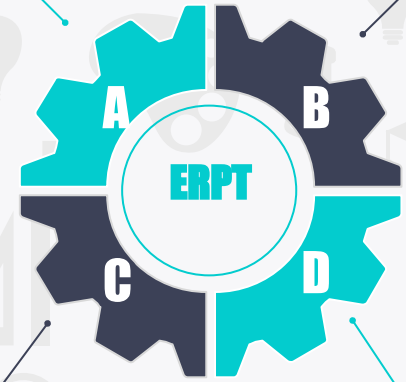
Energy Redistribution Path Tracing

Preprocessing

Get the average luminance of the output image (base image)

Energy Flow

Equally divide the energy(color) in current pixel

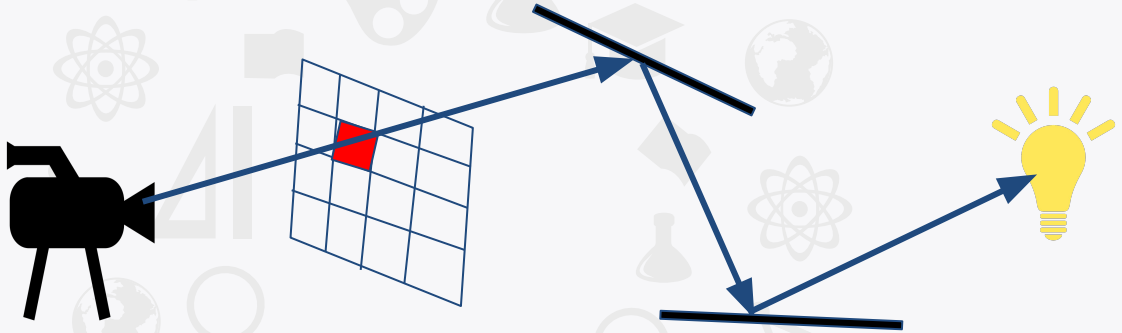


Mutation

Redistribution

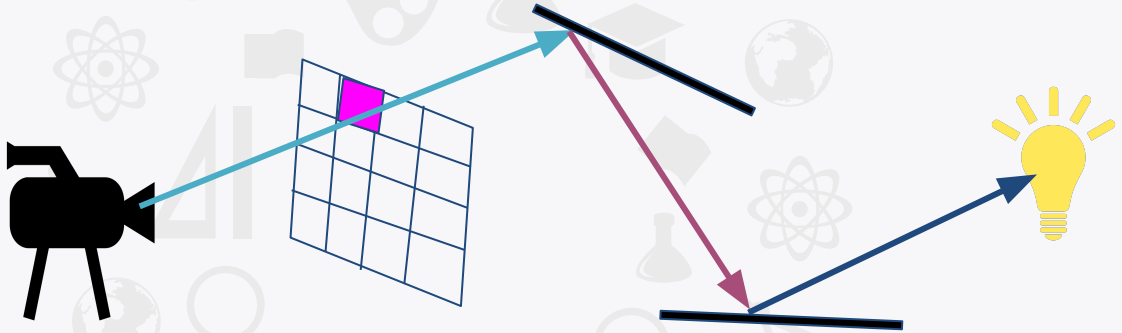
Energy Redistribution Path Tracing

Mutation



Energy Redistribution Path Tracing

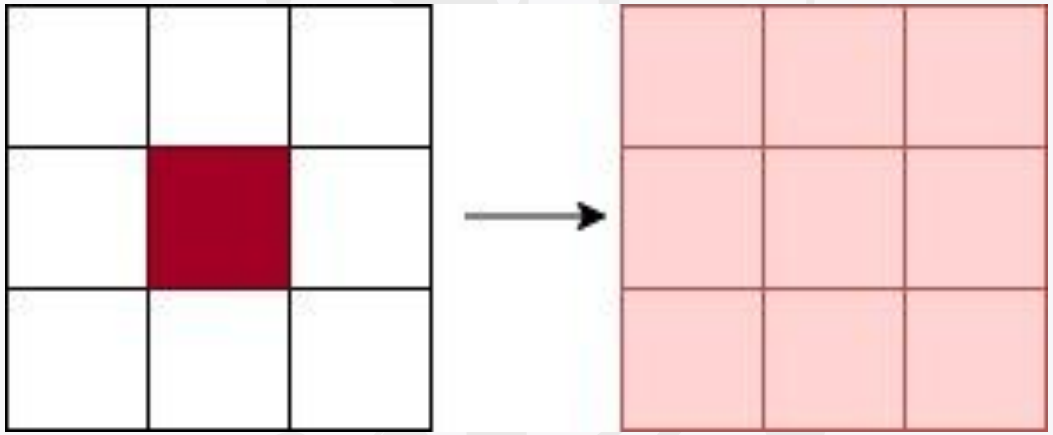
Mutation



Energy Redistribution Path Tracing

Redistribution

distribute the energy if mutation succeeds



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PART THREE

Setup

- References
- Code arrangement
- Features
- Output method

Reference

References

[1]Peter Shirley, Ray Tracing in One Weekend, Version 3.1.1, 2020-05-16

[2]Peter Shirley, Ray Tracing: The Next Week, Version 3.1.1, 2020-05-16

[3]Matt Pharr, Wenzel Jakob, and Greg Humphreys, Physically Based Rendering: From Theory To Implementation, 2004

[4]David Cline, Justin Talbot, Parris Egbert, Energy redistribution path tracing, ACM SIGGRAPH2005 pp.1186-1195, July 2005

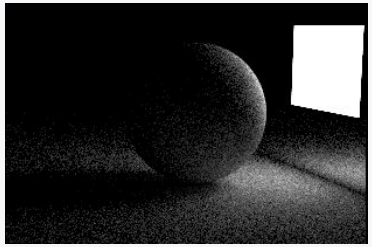
[5]Eric veach, Robust Monte Carlo methods for light transport simulation, chapter 10 ‘bidirectional path tracing’, Stanford University, 1997

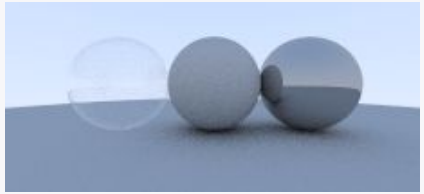
[6]Kajiya J. T. 1986. The Rendering Equation. In SIGGRAPH 1986.

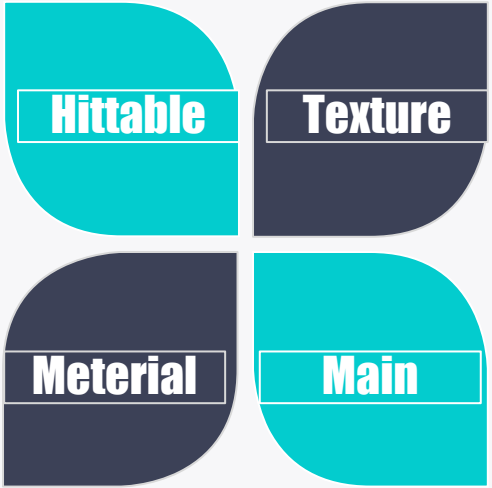
[7]Z.Liu, The study of path tracing based Energy Redistribution Global Illumination Method, Tianjin University, June 2007

[8]Jacco Bikker, INFOMAGR – Advanced Graphics in Utrecht University, 2016

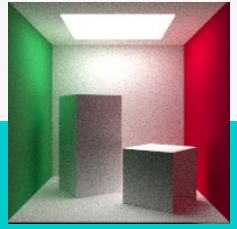
Code Arrangement







Features

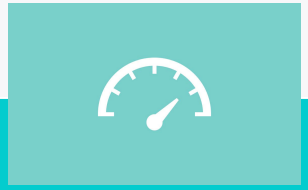


Light transport

- Diffuse Inter-reflection
- Soft Shadow
- Color Bleeding

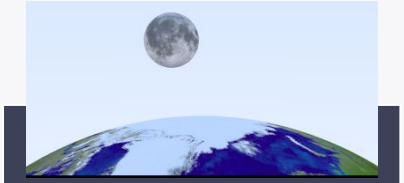
4 different algorithms

In order to compare the performance between different tracing algorithms



Multi-threading

Using multi-threading to accelerate the programme process



Texture

Texture that maps to the surface of an object

Result

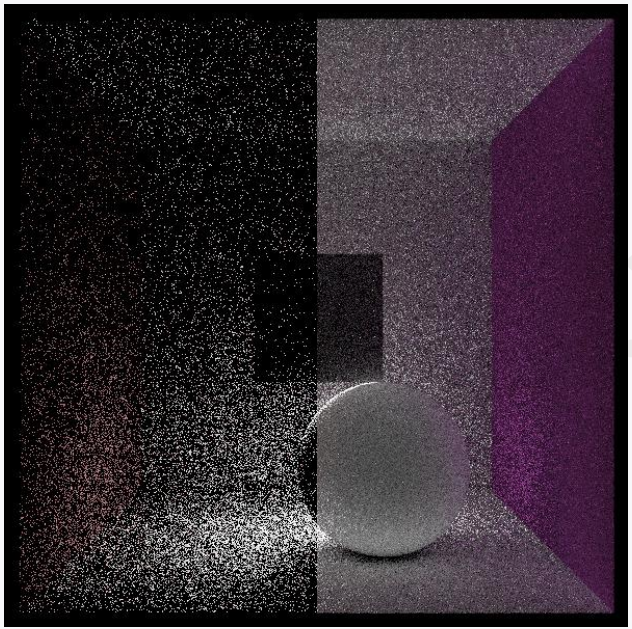
04

PART FOUR

- Improvement
- Comparison

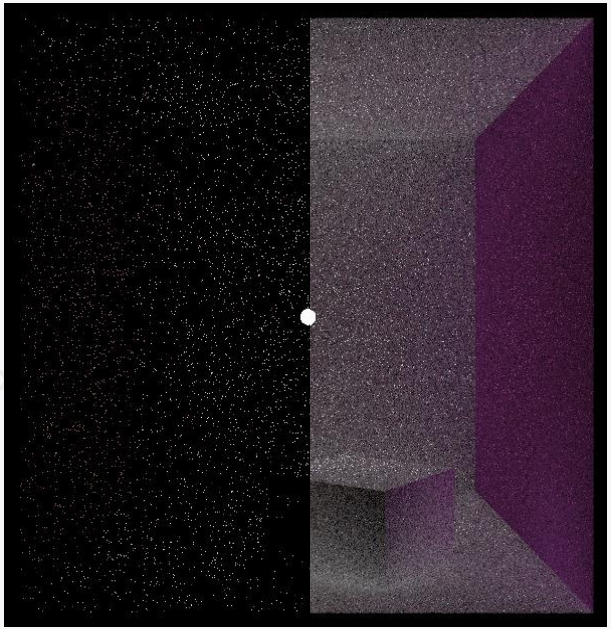
16 samples per pixel

Output BDPT against PT



Left: path tracer / 14 seconds
Right: BDPT / 27 seconds

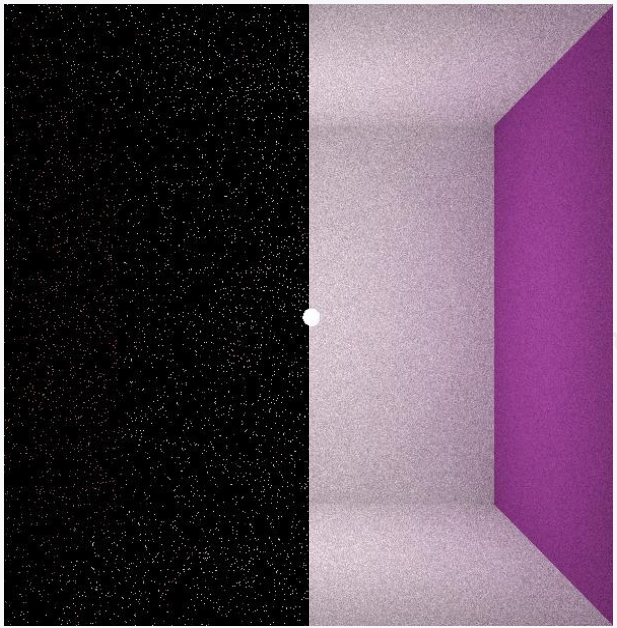
Left: path tracer / 4 seconds
Right: BDPT / 8 seconds



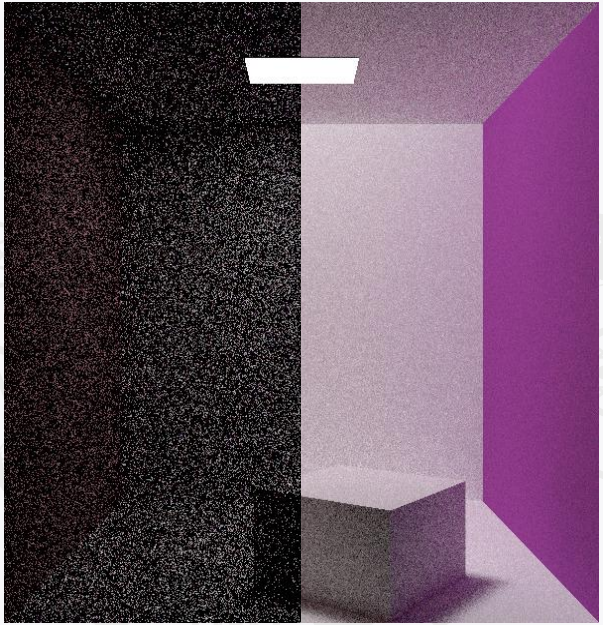
Left: path tracer / 15 seconds
Right: BDPT / 28 seconds

16 samples per pixel

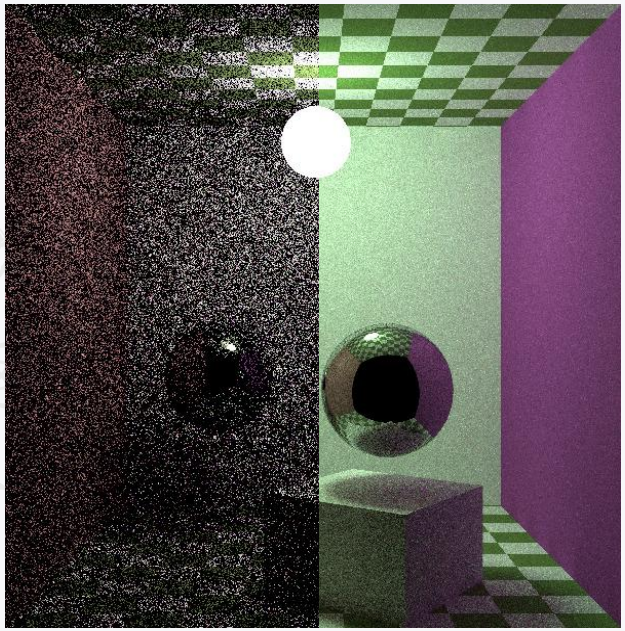
Output NEE against PT



Left: path tracer / 14 seconds
Right: with NNE / 20 seconds



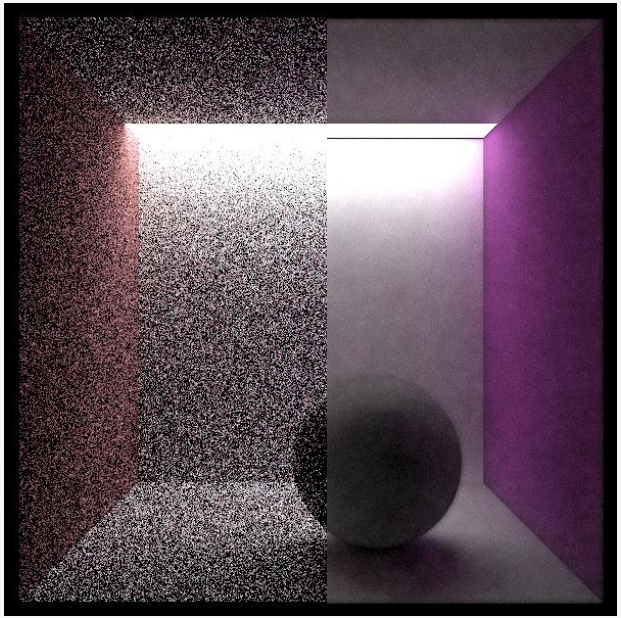
Left: path tracer / 18 seconds
Right: with NNE / 20 seconds



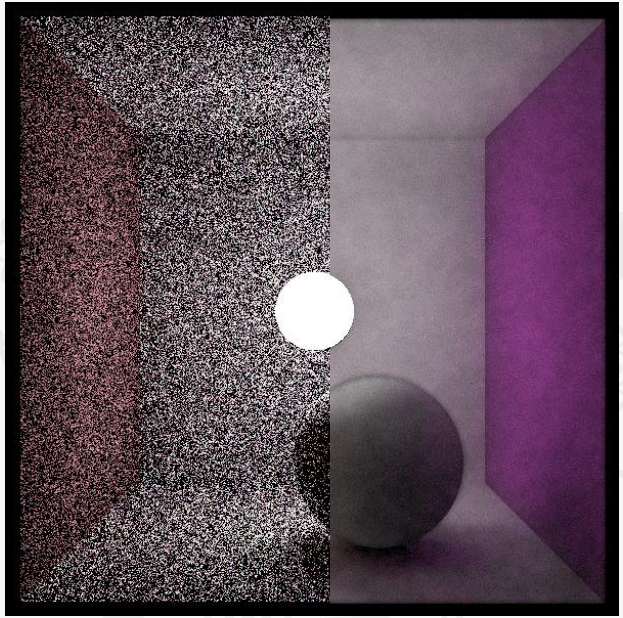
Left: path tracer / 20 seconds
Right: with NNE / 27 seconds

16 samples per pixel

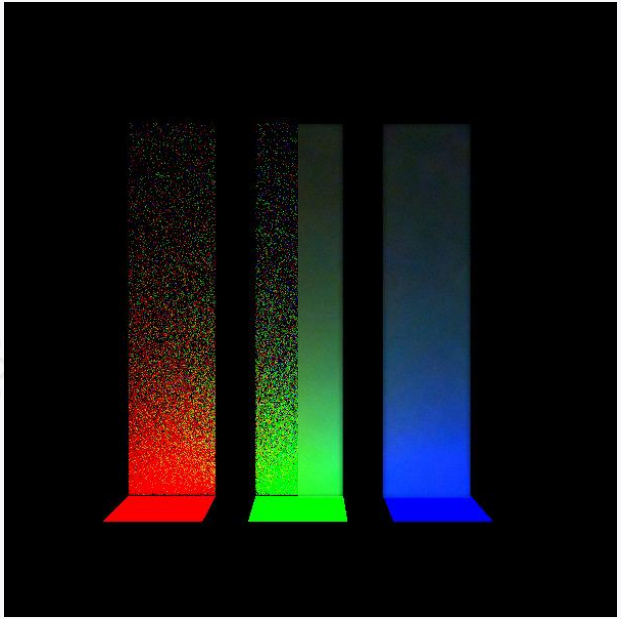
Output ERPT against PT



Left: path tracer / 14 seconds
Right: ERPT(10 mutations)
/ 99 seconds



Left: path tracer / 13 seconds
Right: ERPT(10 mutations)
/ 87 seconds

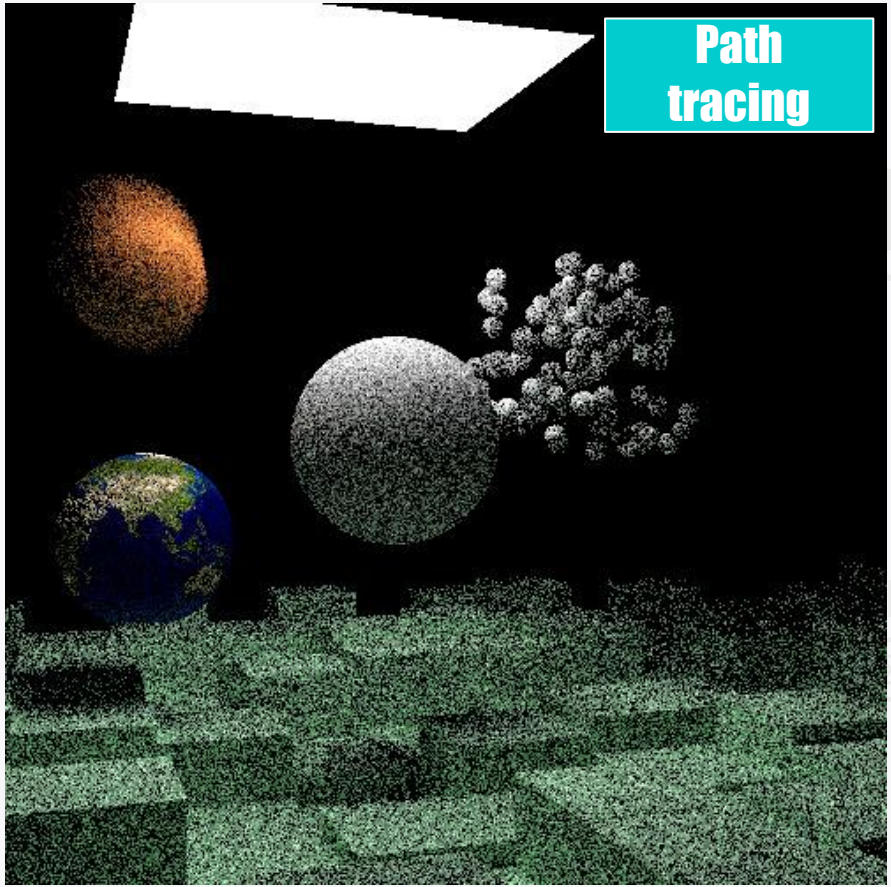


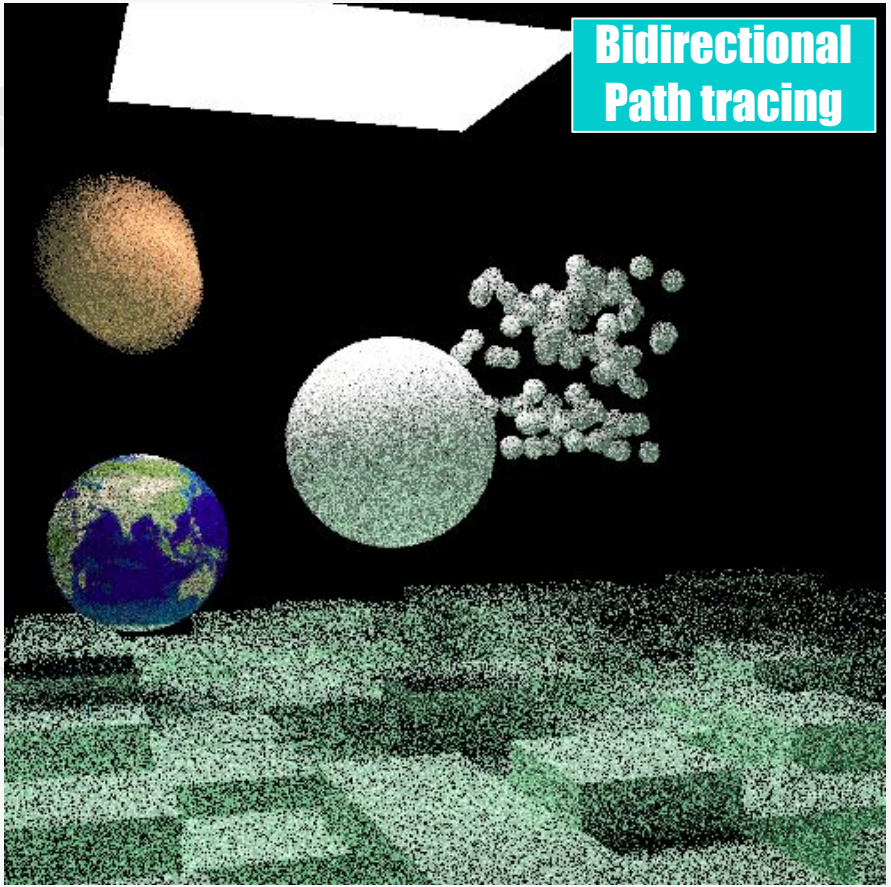
Left: path tracer / 4 seconds
Right: ERPT(10 mutations)
/ 26 seconds

Multiple objects 800 seconds

Multiple objects 800 seconds

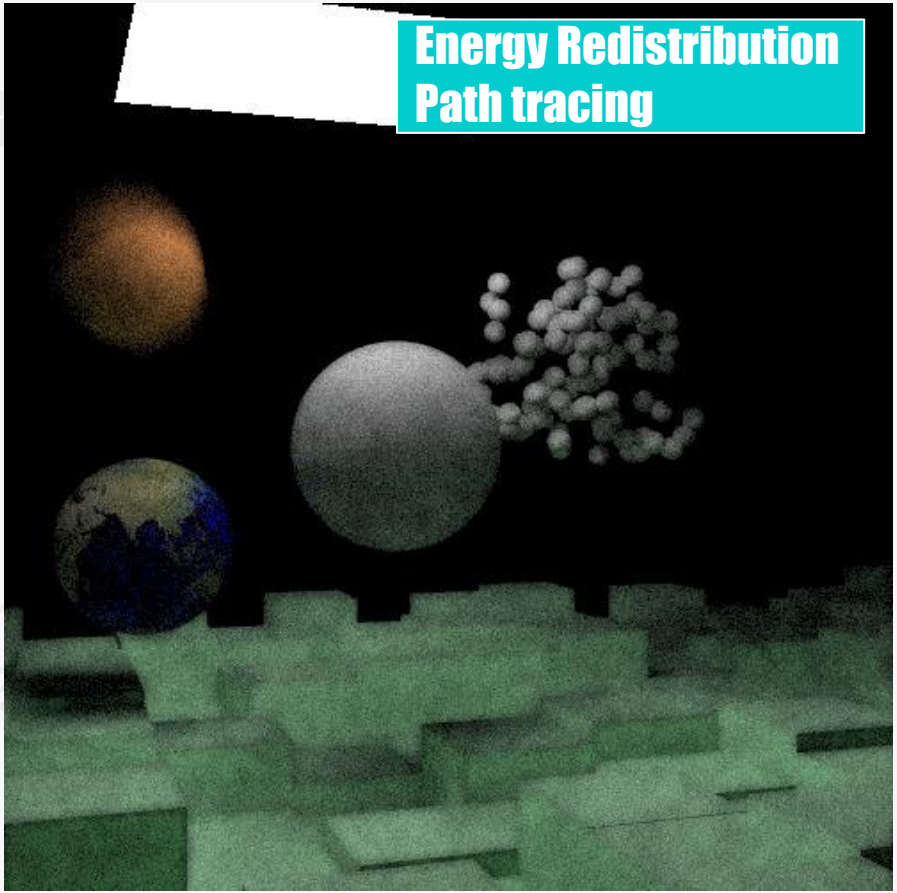
Multiple objects 800 seconds



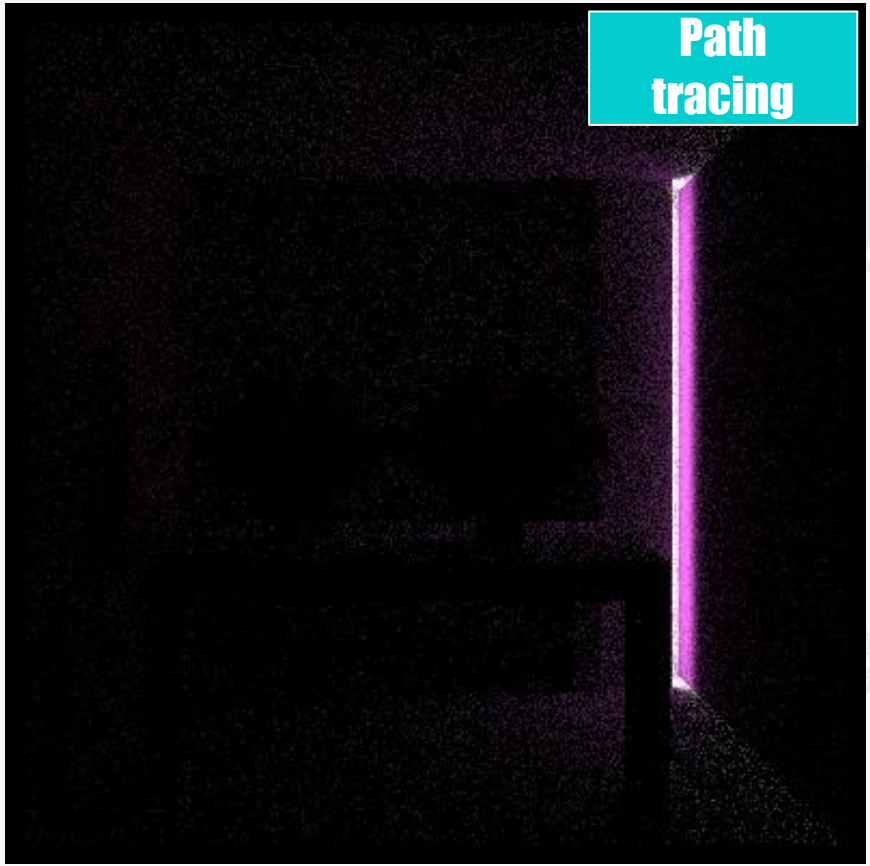


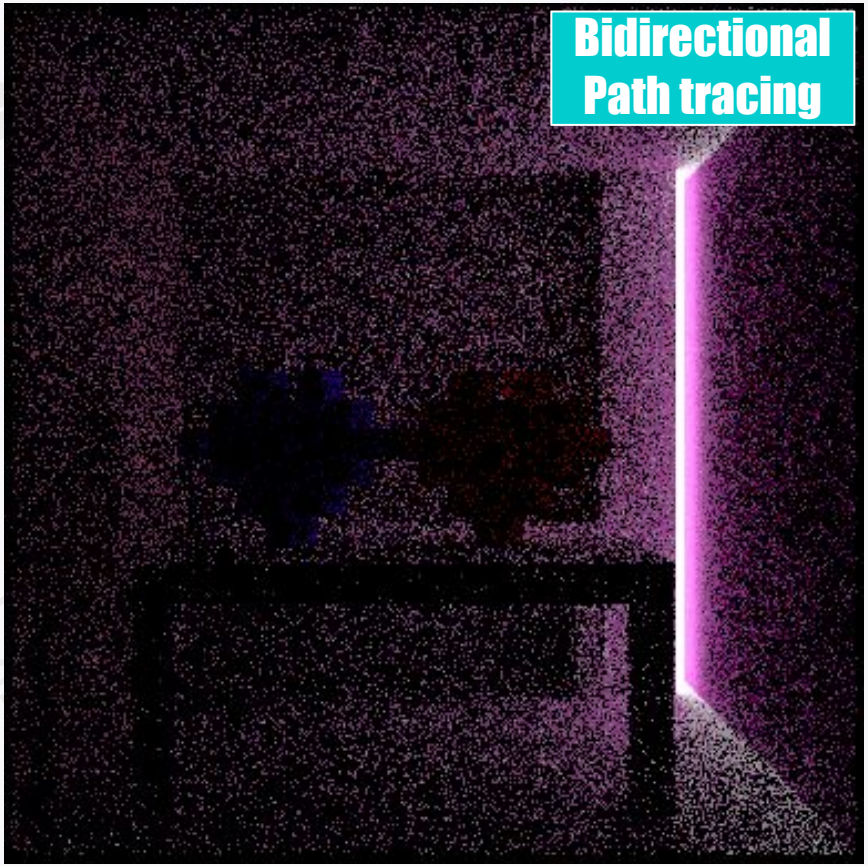
Output

Multiple objects 800 seconds



Multiple objects 800 seconds





Multiple objects 800 seconds

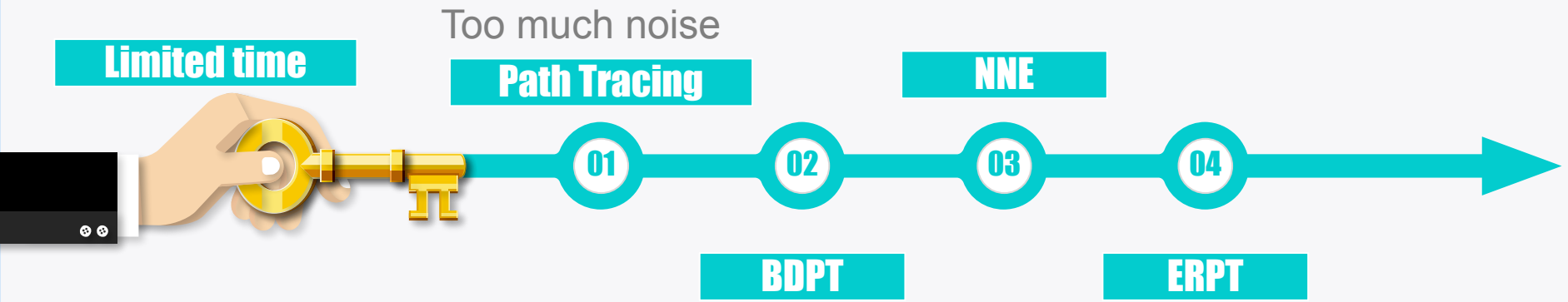
Conclusion

05

PART FIVE

- **Answer & Reflection**

Answer & reflection



Thank you for watching