

# Project 1 Ray Tracer Demonstration

Qiong Wang  
University of Pennsylvania  
CIS 565 - Fall 2013



# Features Implemented

## ■ Basic Features

- ☐ Raycasting from a camera into a scene through a pixel grid
- ☐ Phong lighting for one point light source
- ☐ Diffuse lambertian surfaces
- ☐ Raytraced shadows
- ☐ Cube intersection testing
- ☐ Sphere surface point sampling

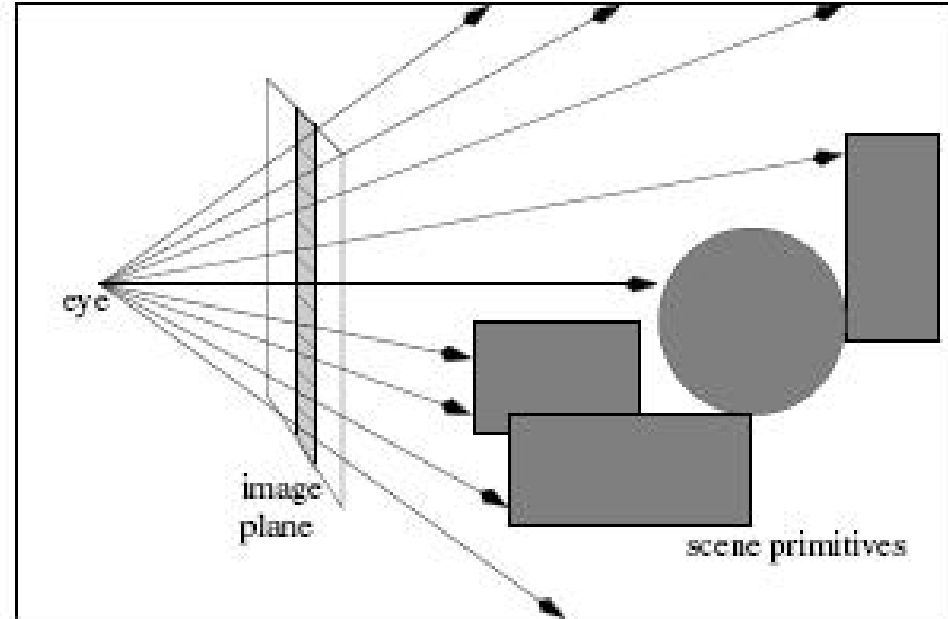
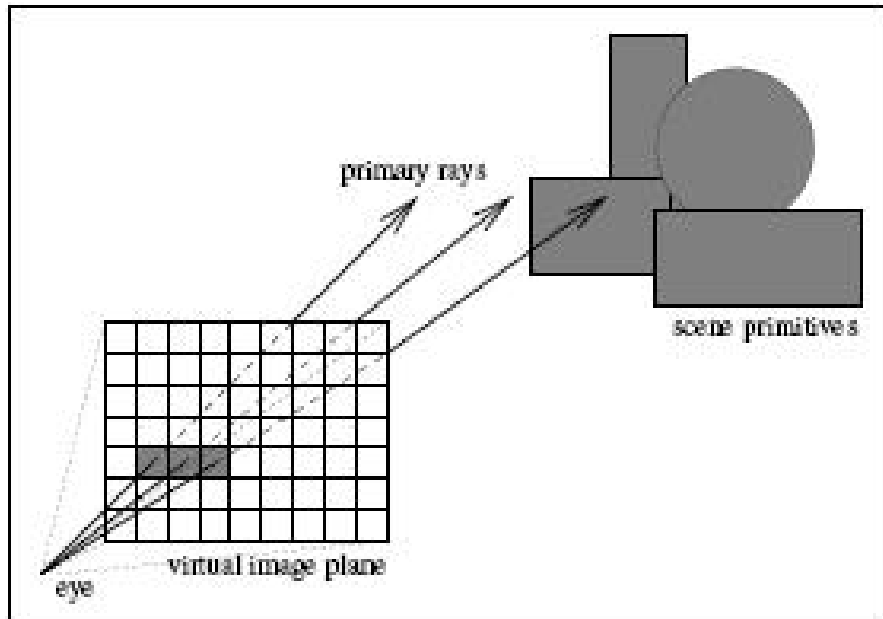
## ■ Optional Features

- ☐ Specular reflection (optional)
- ☐ Soft shadows and area lights (optional)

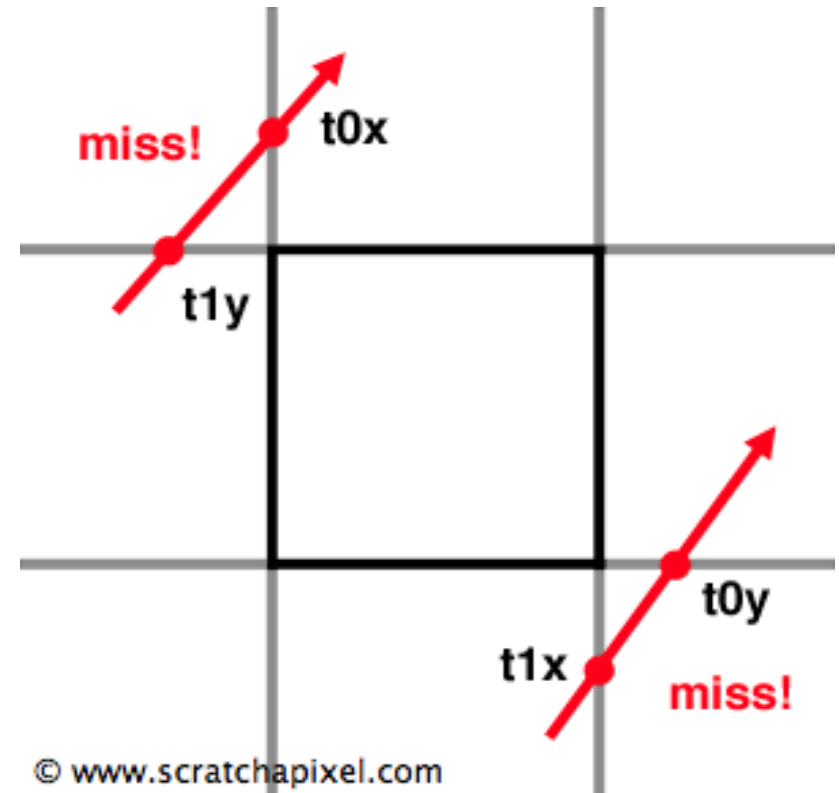
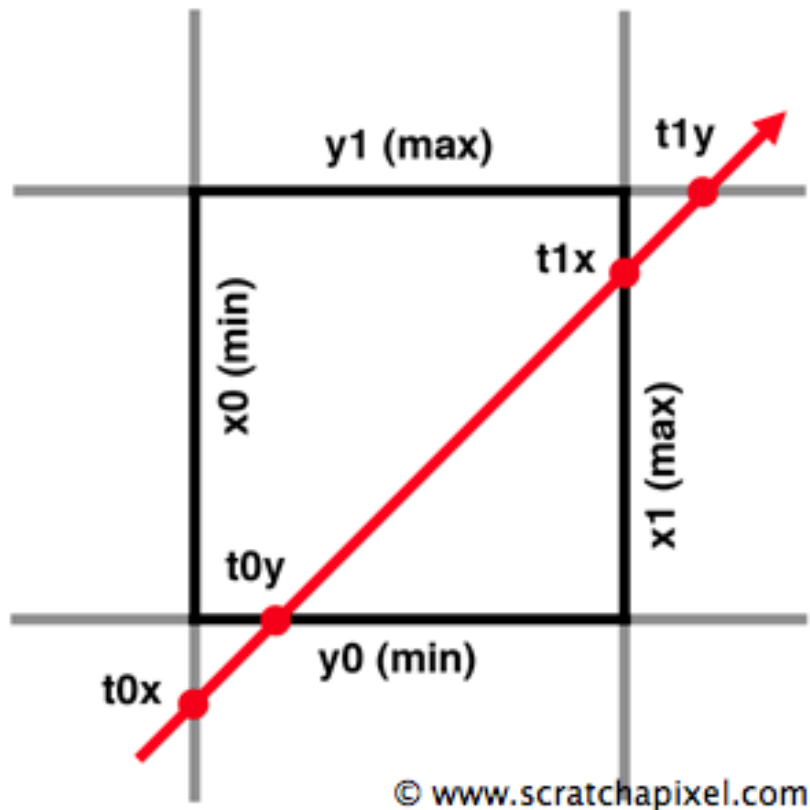
# Ray Tracing Algorithm

```
for each pixel
{
    Construct ray from camera through pixel
    Find first primitive hit by ray
    Determine color at intersection point
    Draw color
}
```

# Ray Tracing Algorithm



# Box Intersection





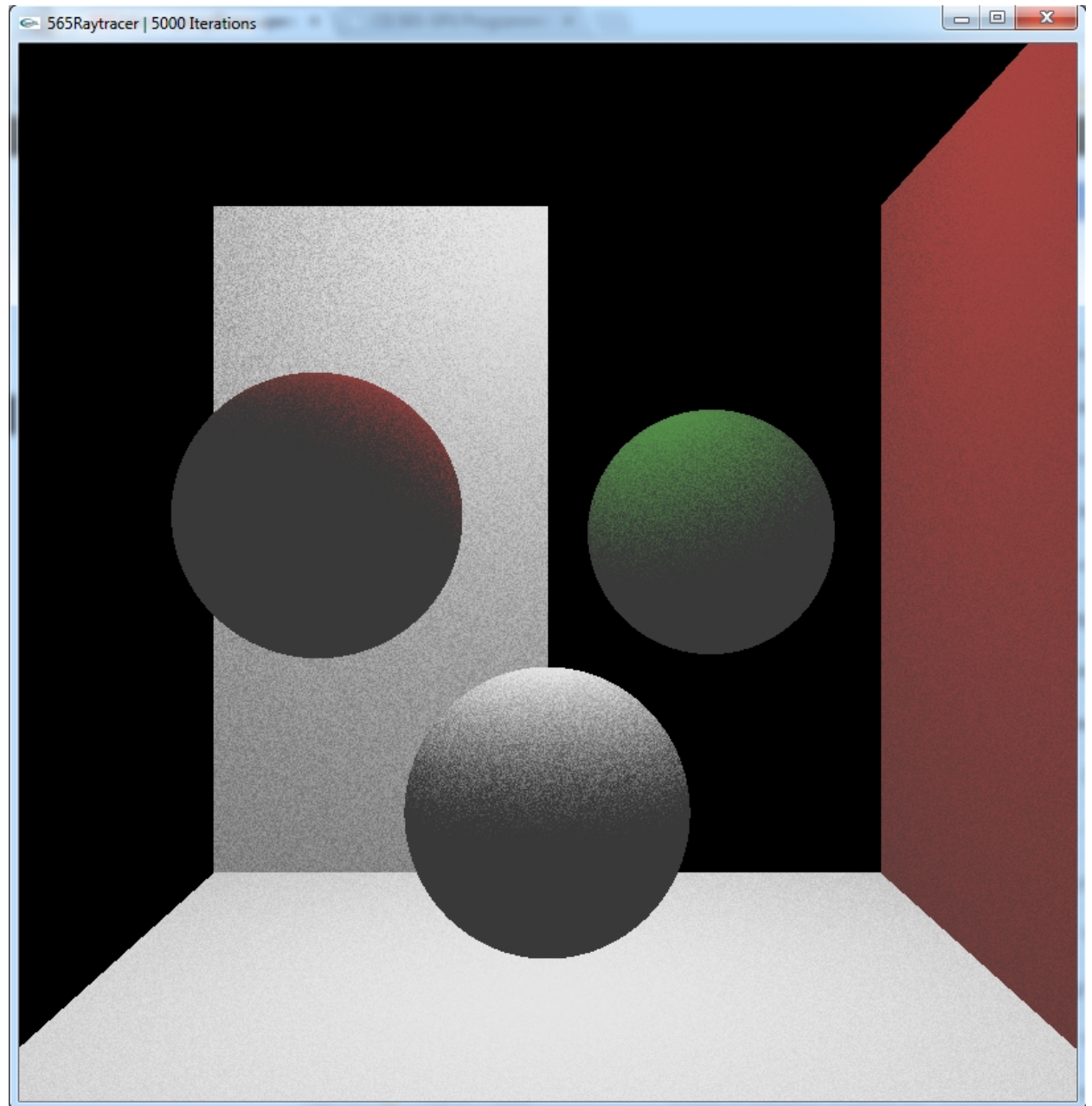
# Bidirectional Reflectance Distribution Functions (BRDFs)

- Define how lights is reflected at a given opaque surface
- Reflectance models
  - Ideal Specular(mirrors)
  - Ideal Diffuse



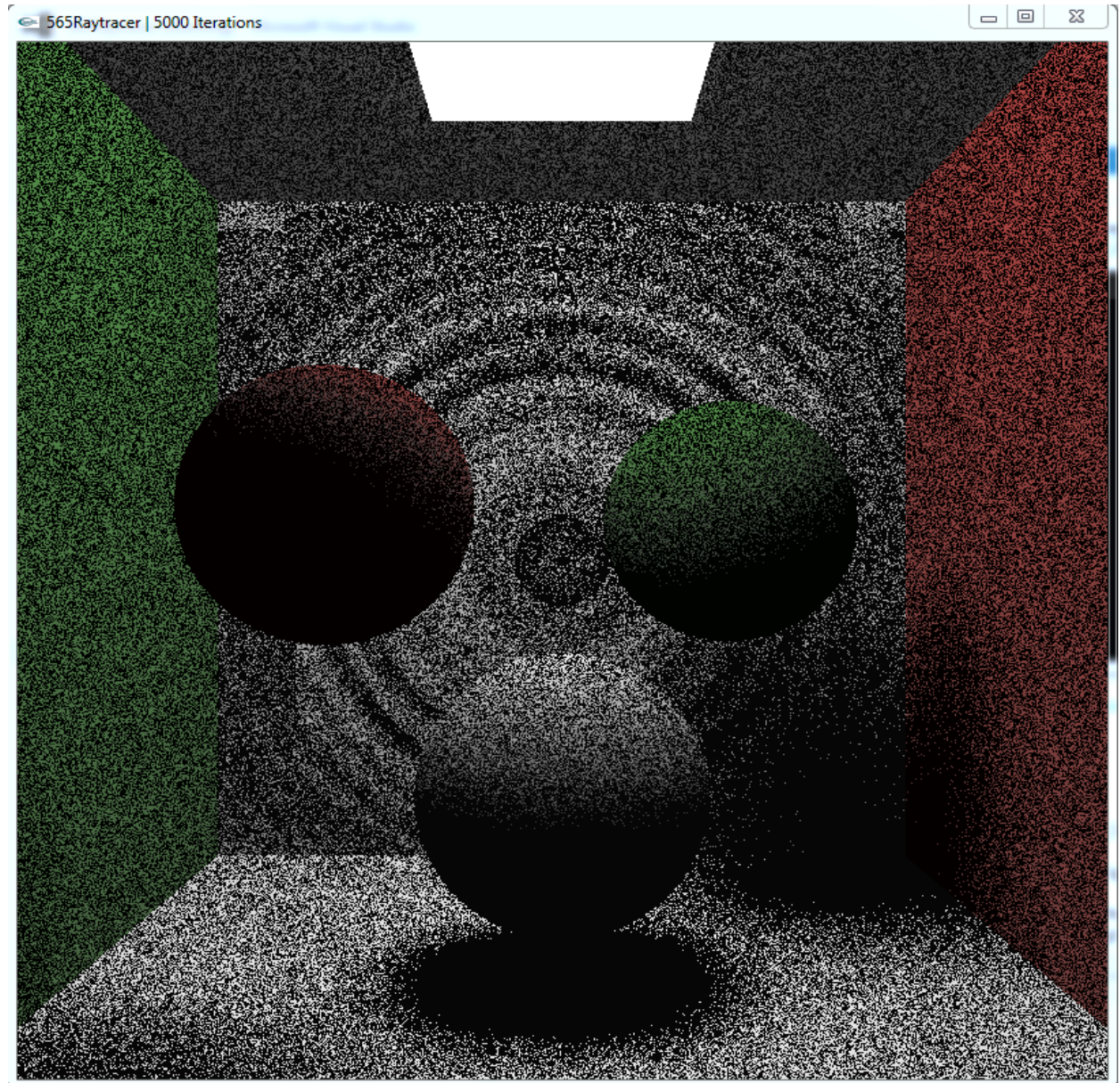
**HARD TRIP STARTED!**

Result with  
wrong box  
intersect-  
ion



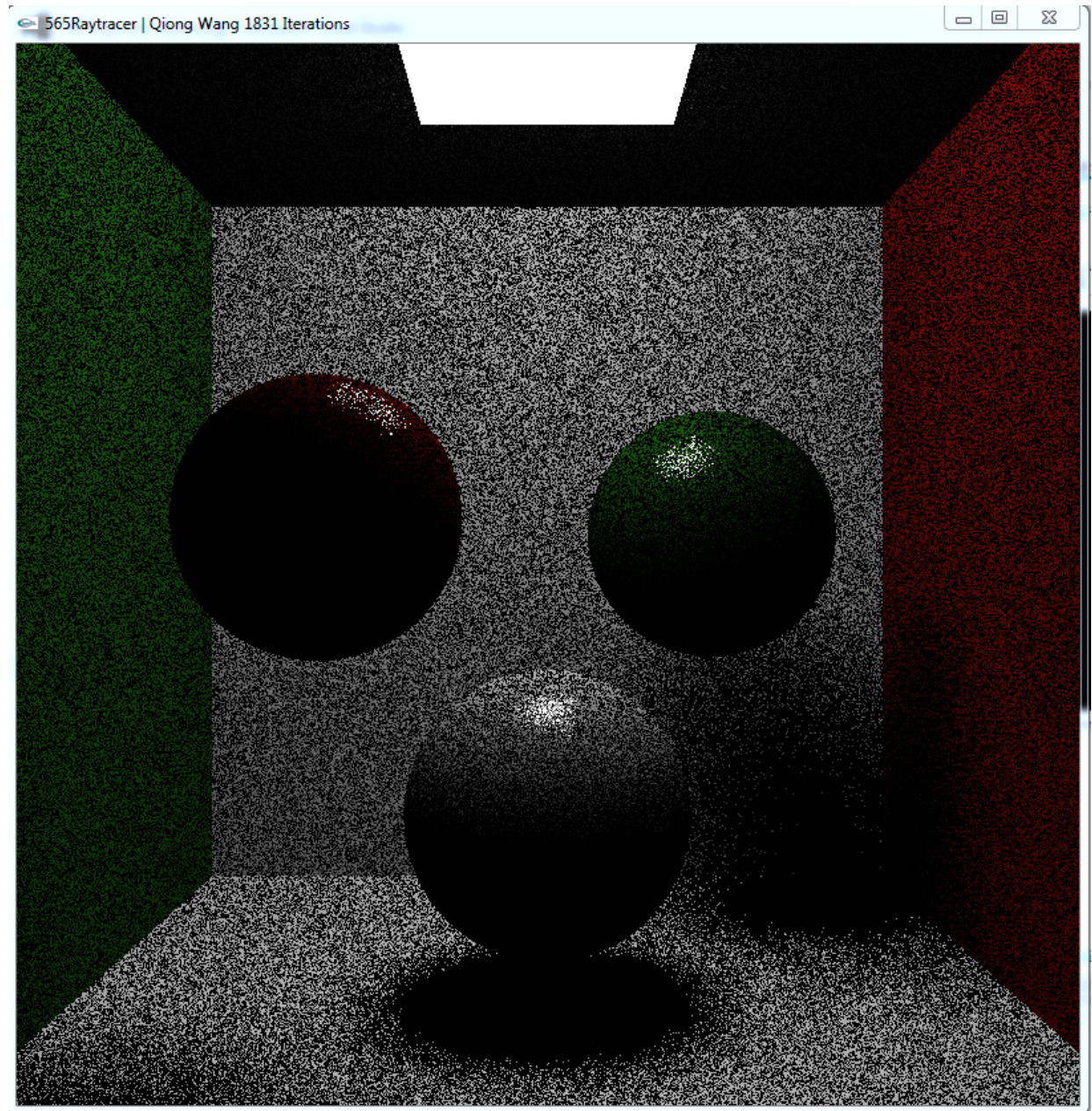


Result with  
right box  
intersect-  
ion and  
apparent  
artifacts

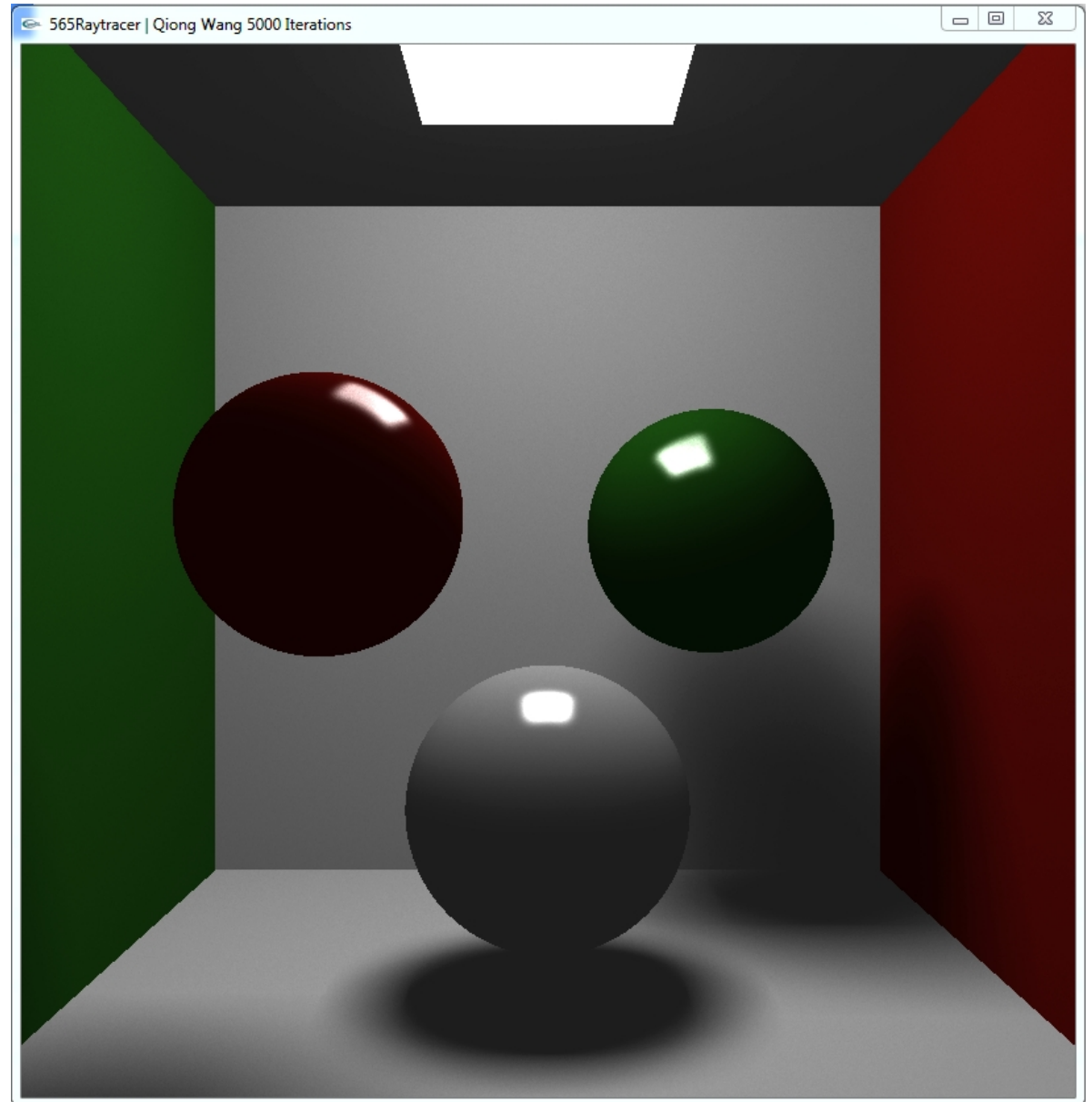




Result  
with  
noise



# Final Result



# Performance Evaluation

| tileSize | Total time per 1000 iterations | fps   |
|----------|--------------------------------|-------|
| 1        | 2 : 22.7                       | 7.00  |
| 2        | 0 : 49.2                       | 20.33 |
| 4        | 0 : 17.4                       | 57.47 |
| 8        | 0 : 16.9                       | 59.17 |
| 16       | 0 : 16.5                       | 60.61 |

The processing rate changes when using different *tileSize*

# References

- Ray Tracing Algorithm:
  - <http://cse.csusb.edu/tong/courses/cs621/notes/ray.php>
- Ray Tracing Pseudo-Codes
  - <http://www.cs.unc.edu/~rademach/xroads-RT/RTarticle.html>
- Box Intersection
  - <http://www.scratchapixel.com/lessons/3d-basic-lessons/lesson-7-intersecting-simple-shapes/ray-sphere-intersection/>
- Cosine-weighted Distribution
  - [http://web.cs.wpi.edu/~emmanuel/courses/cs563/S07/talks/emmanuel\\_agu\\_mc\\_wk10\\_p2.pdf](http://web.cs.wpi.edu/~emmanuel/courses/cs563/S07/talks/emmanuel_agu_mc_wk10_p2.pdf)
- Sphere Geometry
  - <http://en.wikipedia.org/wiki/Sphere>
- Lambertian Surface
  - <http://en.wikipedia.org/wiki/Lambertian>
- Blinn Phong Lighting
  - [http://en.wikipedia.org/wiki/Blin%E2%80%93Phong\\_shading\\_mondel](http://en.wikipedia.org/wiki/Blin%E2%80%93Phong_shading_mondel)
- Ambient Light
  - [http://en.wikipedia.org/wiki/Phong\\_shading](http://en.wikipedia.org/wiki/Phong_shading)