Real-time Application of LTC for Shadow Rendering

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3. Our Solution
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Limitations of LTC

- **No shadows**
  - **Not considered a visibility term (V = 1, always)**
  - **No obstacles between light and material**

$$\int_{\Omega} Light \times BRDF \times Visibility$$

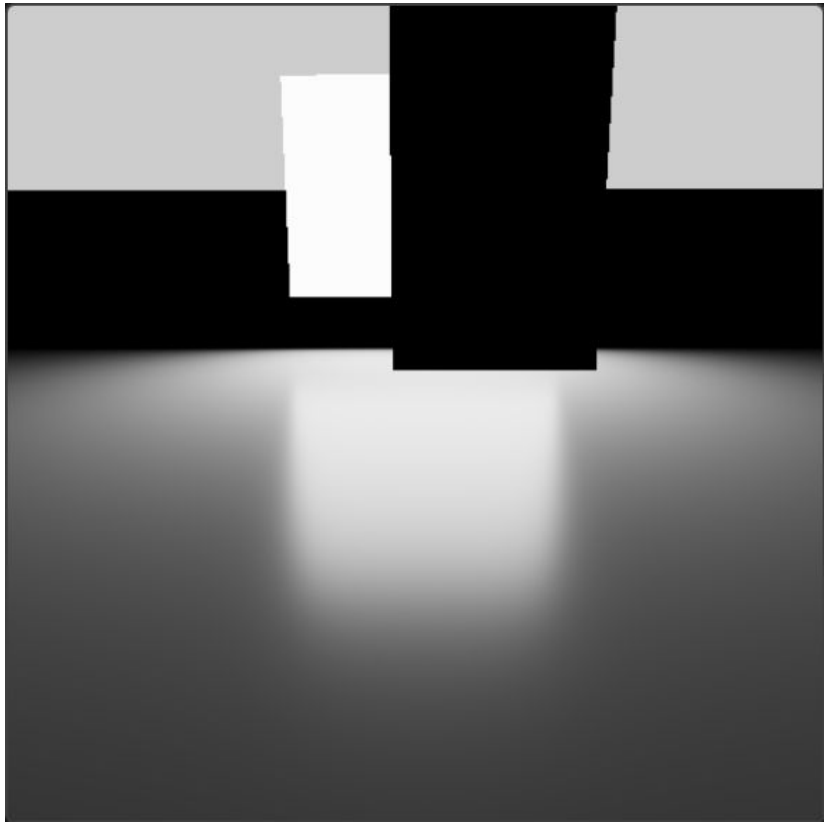
[Heitz2016]

Our Project Scope

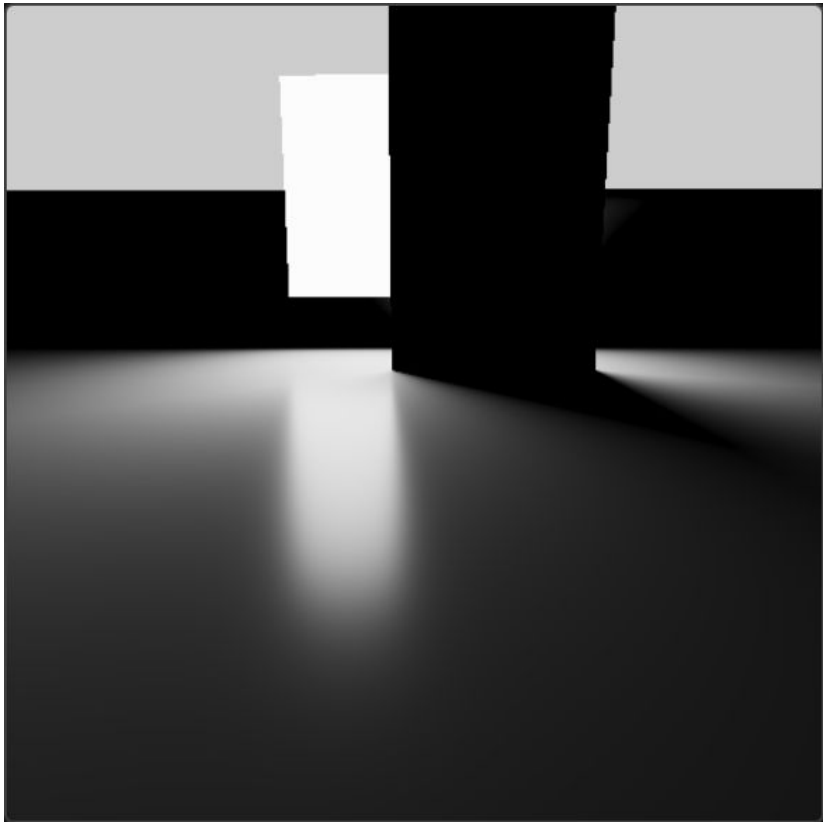
"Efficient Shadow Rendering Using LTC"

Result Overview

Baseline(LTC paper)

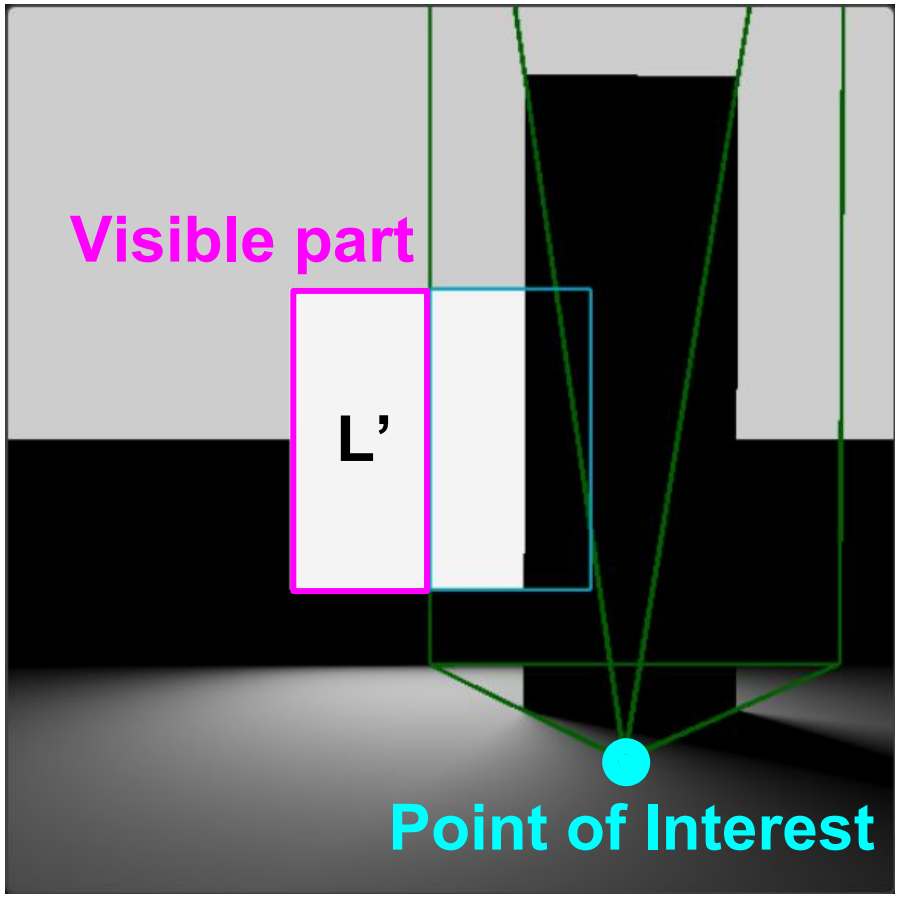


Our improvement!



Our Idea: Geometric Approach

- Limit the integration domain to visible area light

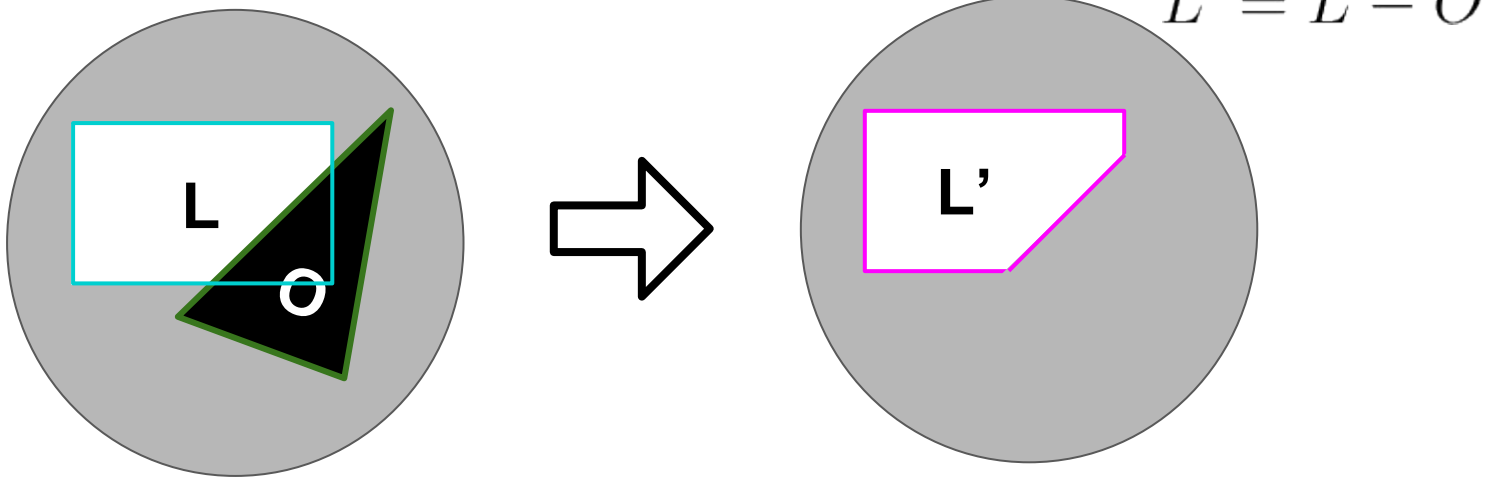


Our Idea: Geometric Approach

- **Limiting integration domain is equivalent to applying visibility term**

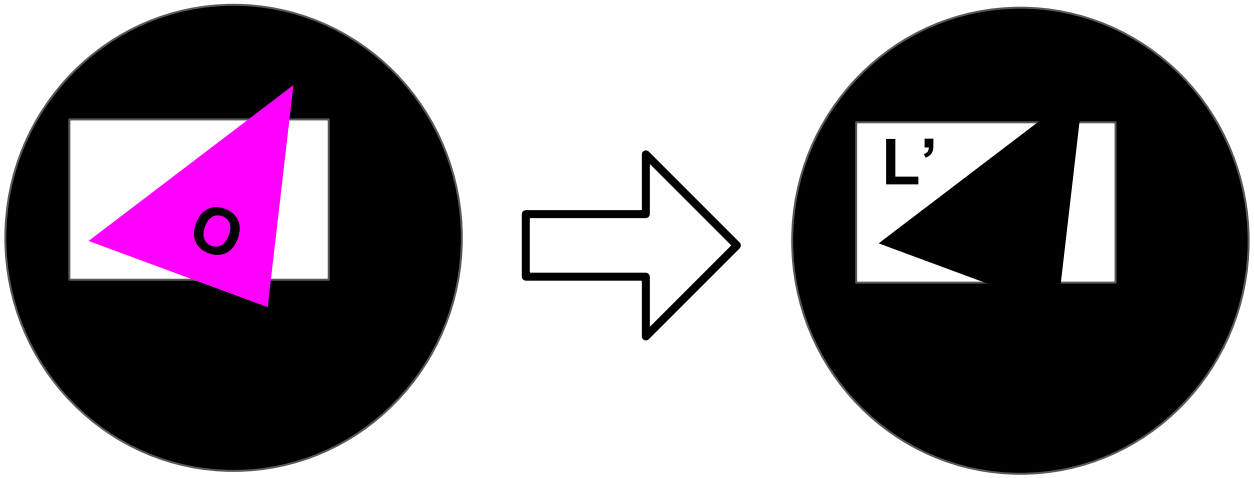
$$\int_L Radiance \times BRDF \times Visibility = \int_{L-O} Radiance \times BRDF$$

$$L' = L - O$$



Practical Problem: Complex Shape

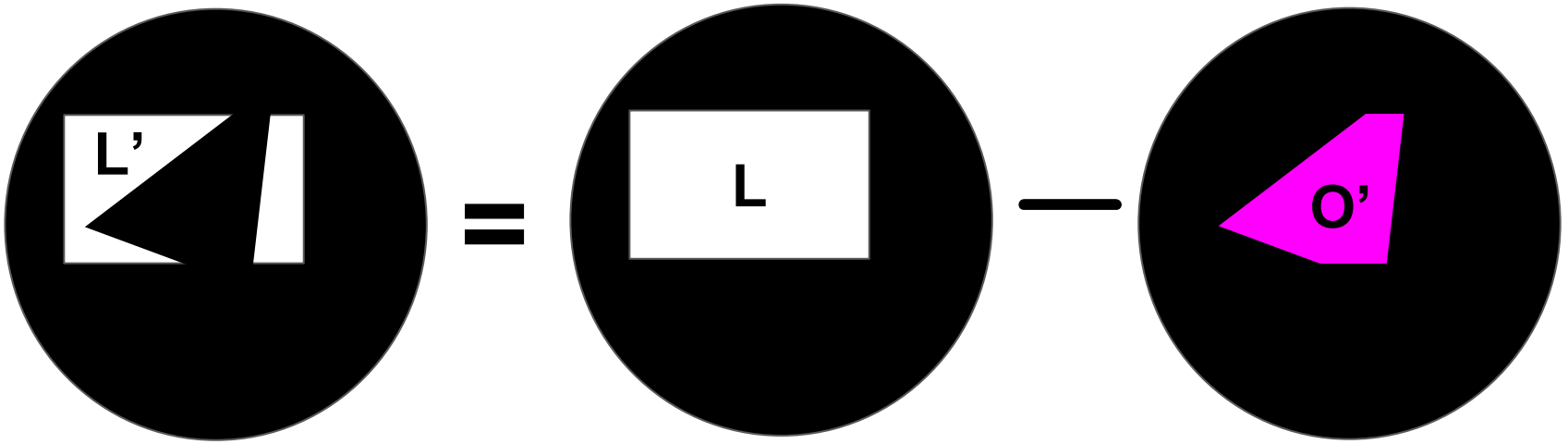
- **Hard to compute the integral over L'**



- **Visible light (L') can be non-convex, not simply connected**

Solution: Separate Integration

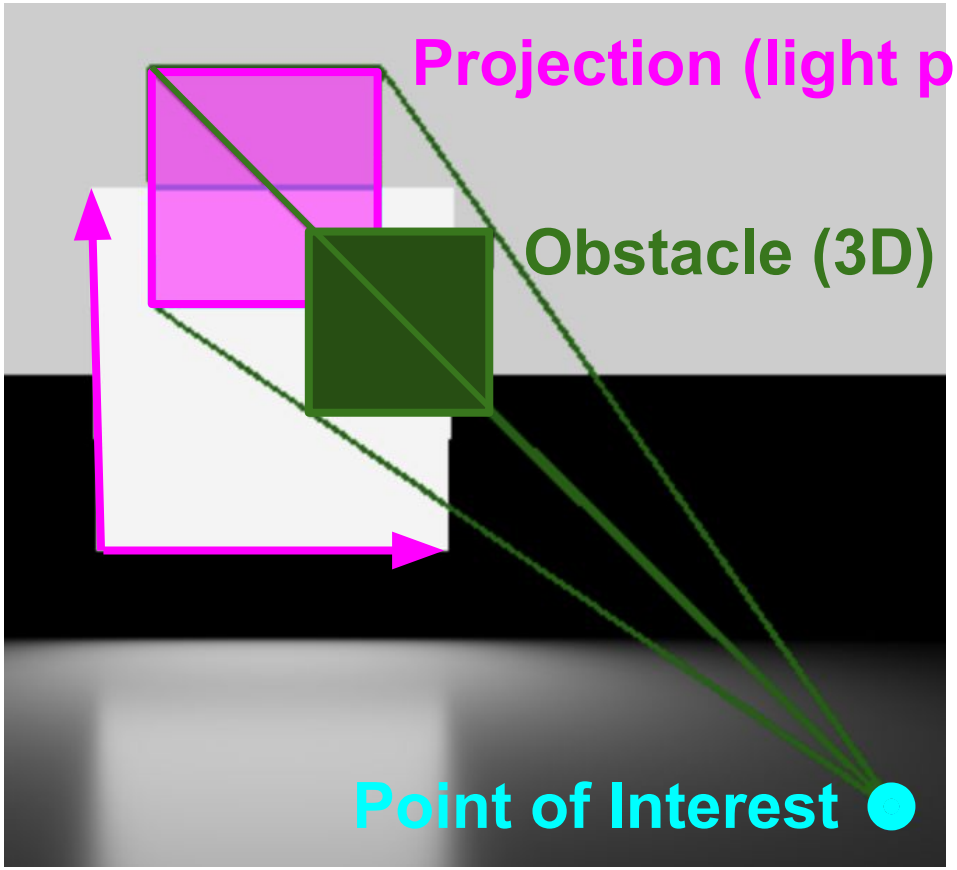
- Integrate separately, then calculate difference
  - 1. Original light
  - 2. Projected clipped obstacle (simpler shape)



$$\int_{L'} = \int_{L-O'} = \int_{L} - \int_{O'}$$

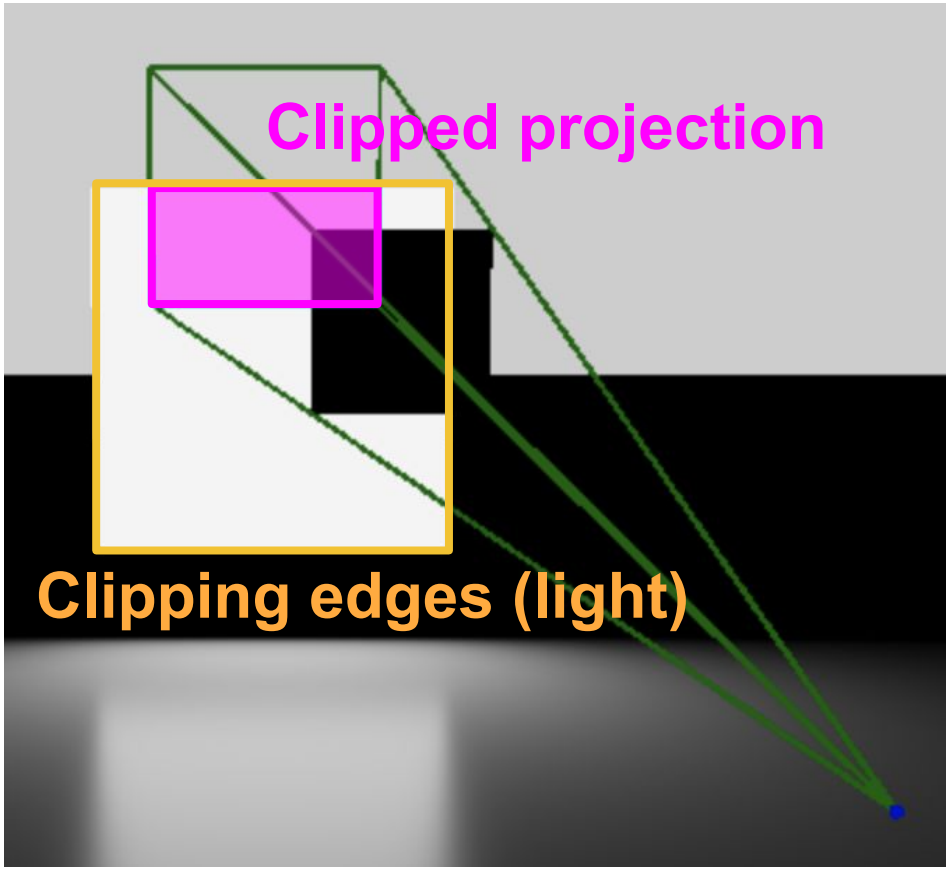
Projection

- **Perspective projection of obstacle to light plane**
  - **Giving 2D light plane coordinates**

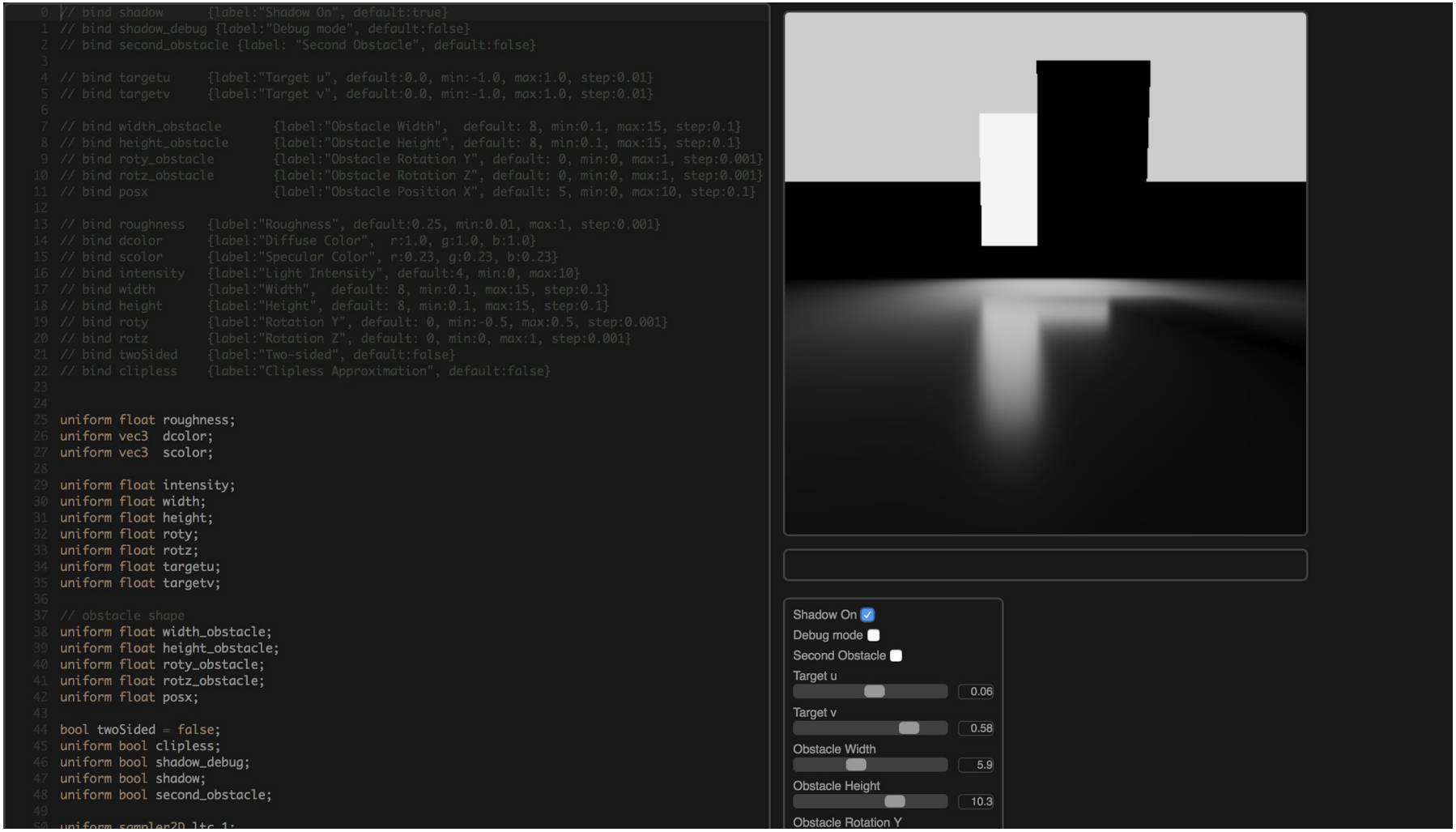


Clipping

- Clipping by light edges
  - Sutherland-Hodgman alg. (2D polygon intersection)

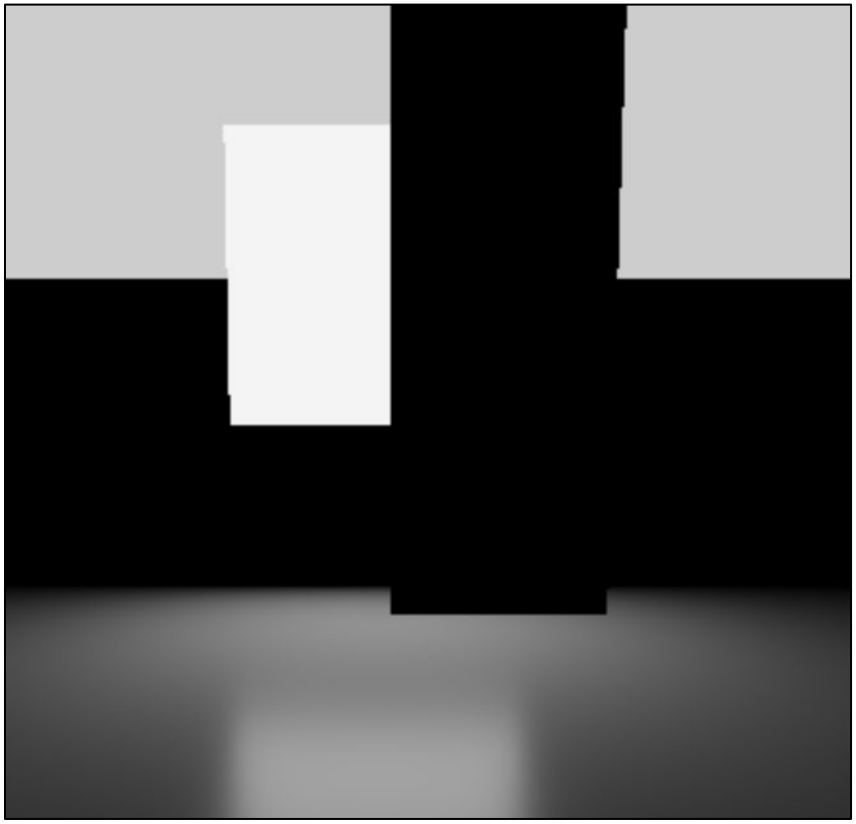


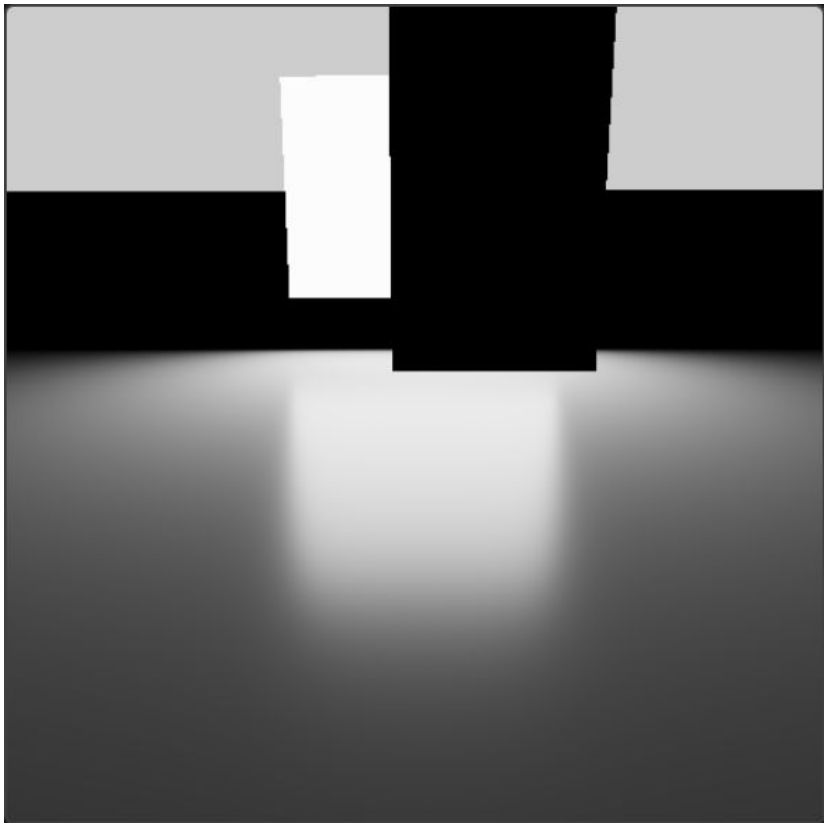
Results: Real-Time Live Demo



Practical Benefits

- Drastic enhancement of the sense of height

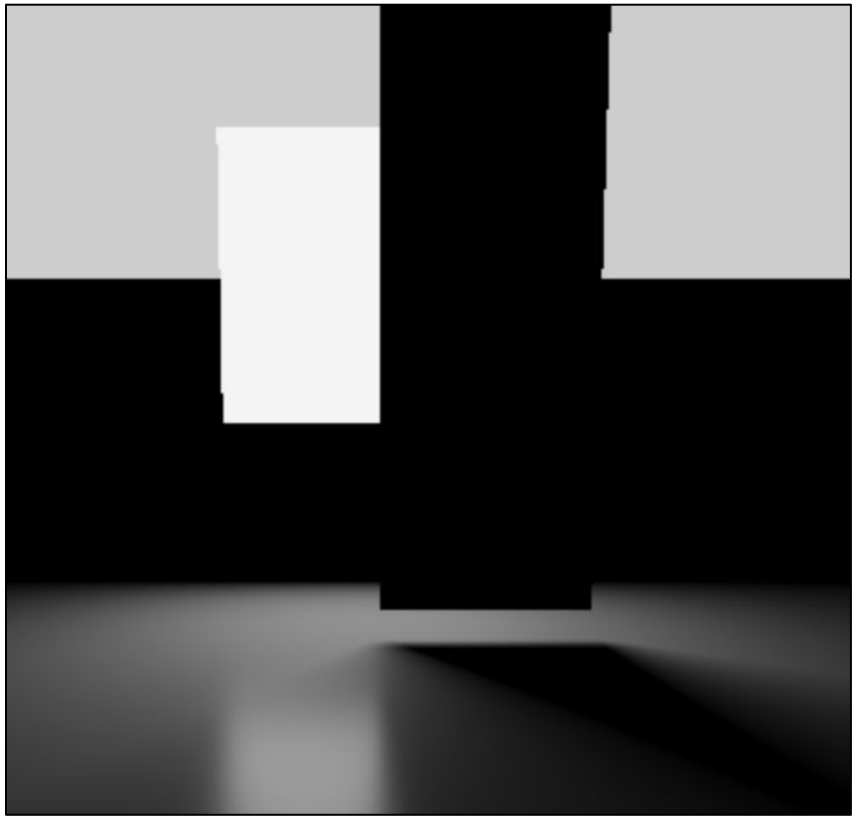




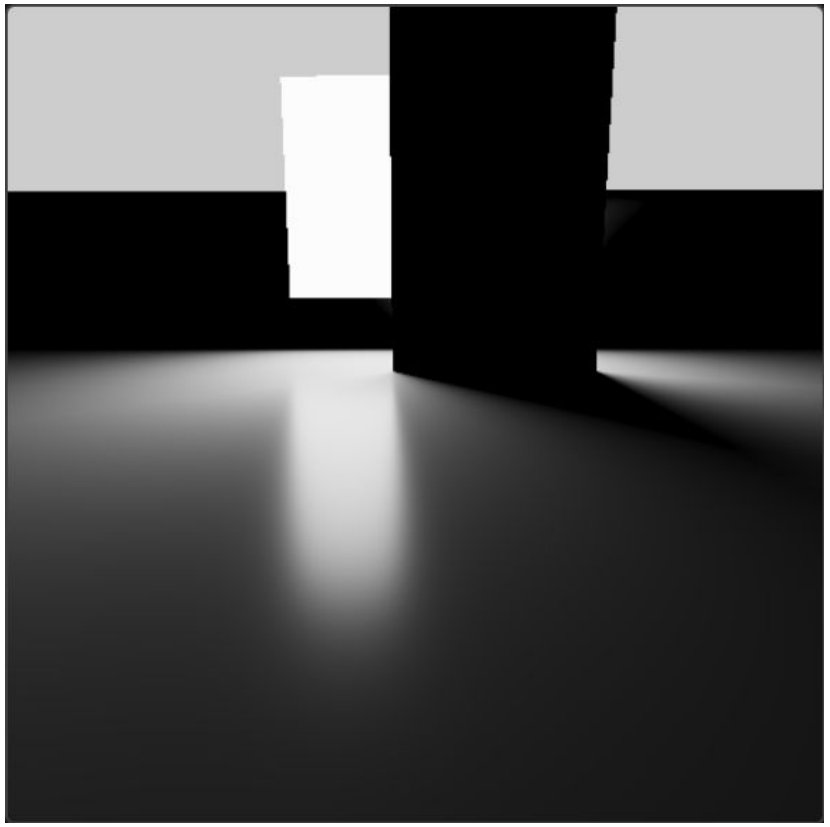
Are they floating in the air?

Practical Benefits

- Drastic enhancement of the sense of height



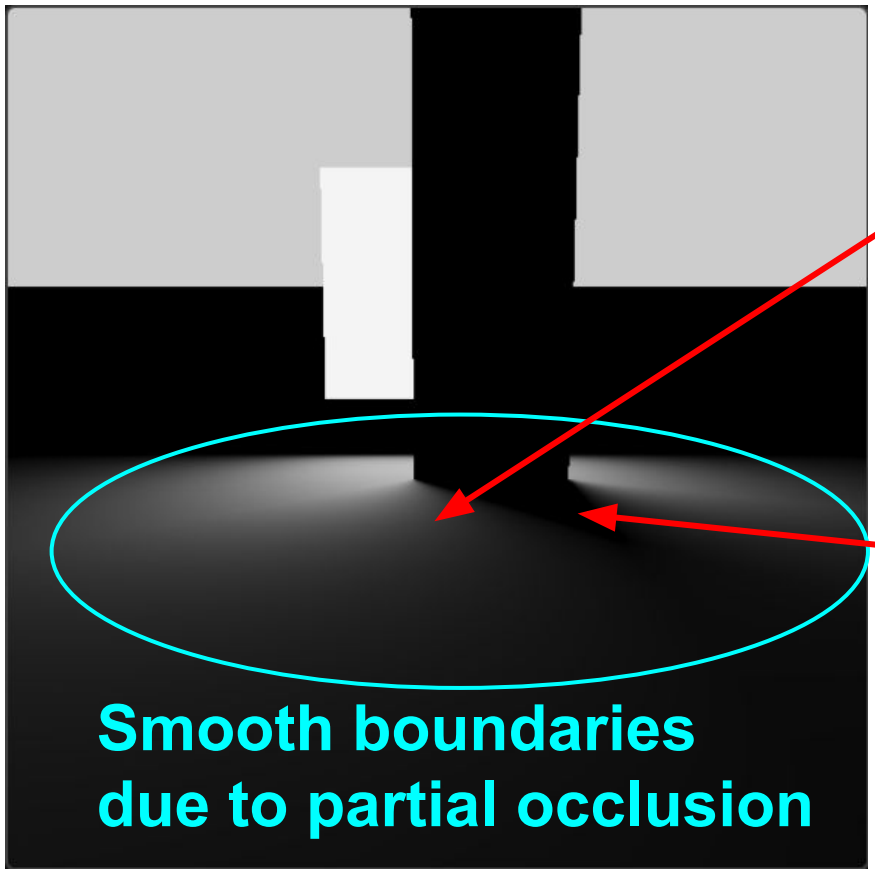
Yes.

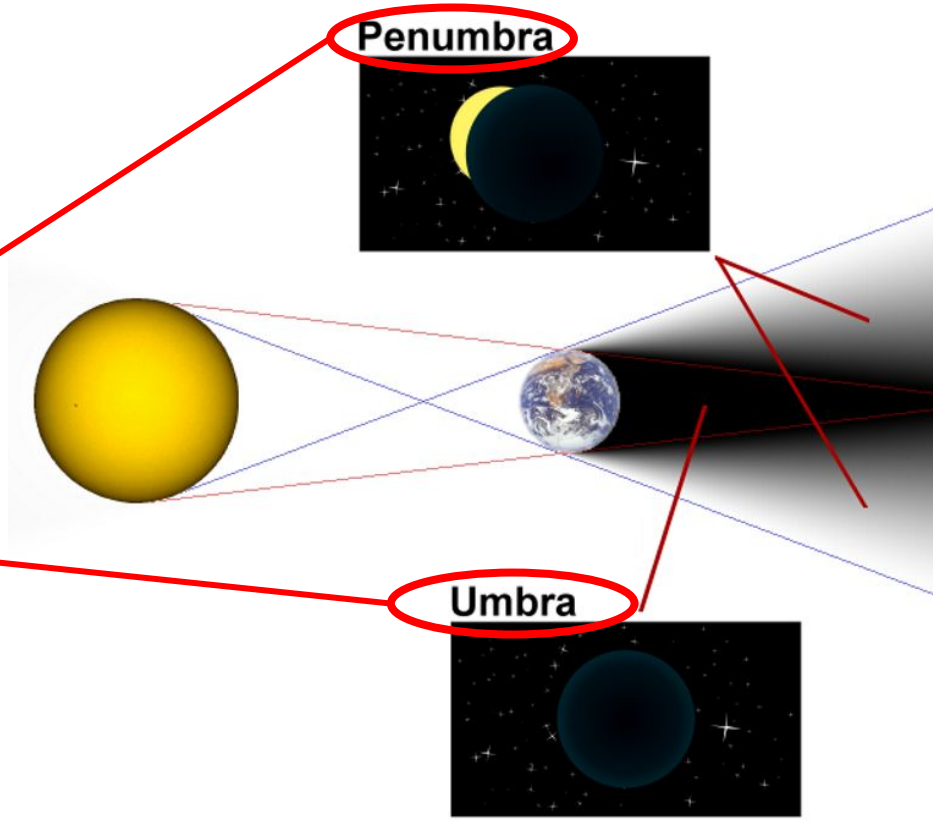


No.

Practical Benefits

- Soft shadow effect for area light source





[Wikipedia] umbra, penumbra and antumbra

Drawbacks

- As usual, additional graphical effects increase computational cost, so does our algorithm
- Main bottleneck
  - 1 projection & 1 clipping / every camera ray
- Need advanced optimization
  - e.g., vertex simplification or parametrization

The Roles of Each Member

- **Eun Hyouk Shin**
  - **Perspective projection**
  - **Clipping**
  - **Visualization tools**
- **In Young Cho**
  - **Draw obstacles**
  - **Generalize the original LTC demo code**
  - **LTC integration for obstacles**
- **Together**
  - **Algorithm design & breakthroughs**

At the End of Our Journey….

- **Shadow rendering**
  - **Visibility term**
- **Separate integration**
  - **integral over the original light**
  - **integral over a projected clipped obstacle**
- **Realistic scenes**