# Fast Indirect illumination Using Two Virtual Spherical Gaussian Lights

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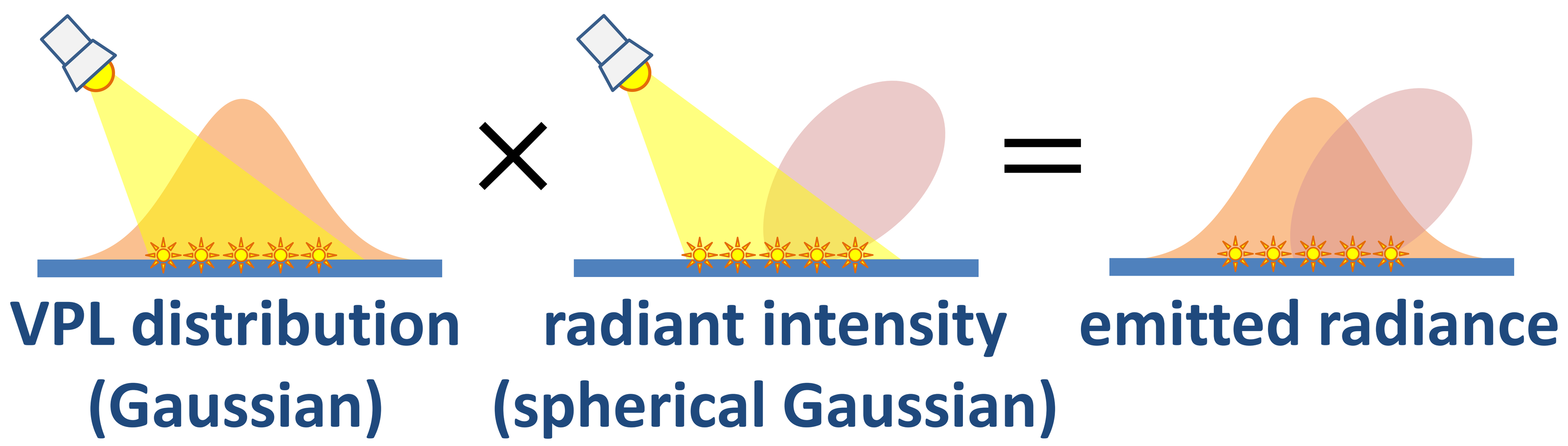
## 1. Introduction

For time-sensitive applications such as video games, this poster demonstrates **dynamic glossy indirect illumination in 1 ms** using only two virtual spherical Gaussian lights (VSGLs) [Tokuyoshi 2015]. This rough approximation is **suitable for scenes which are locally lit by a spot light (e.g., flashlight in a cave)**. To generate these two VSGLs on-the-fly, this poster presents a specialized implementation which is fast and memory saving.

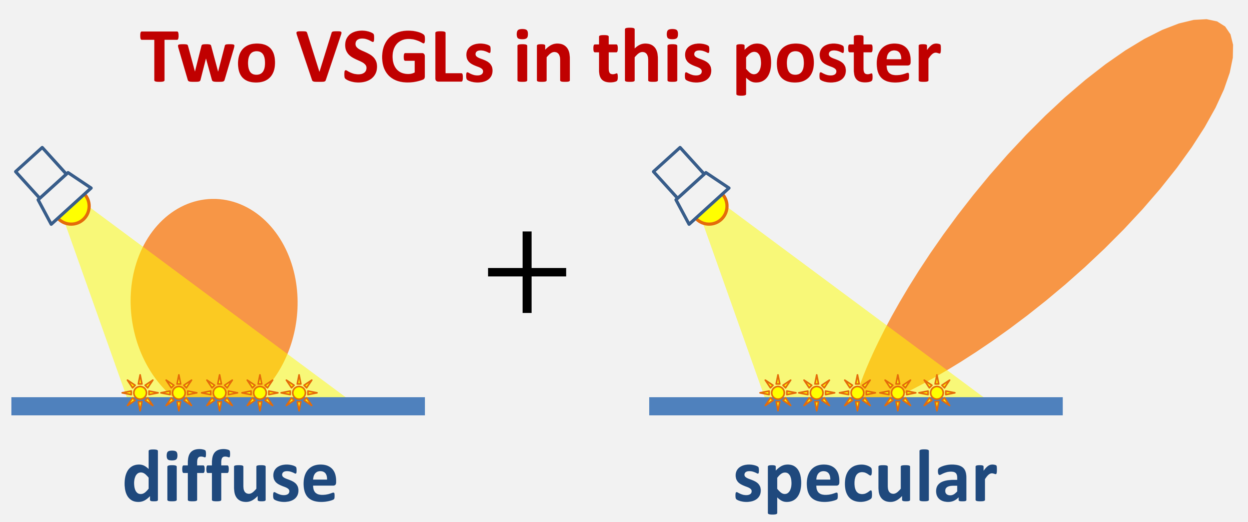
## 2. Virtual Spherical Gaussian Lights

**Approximation of a set of virtual point lights (VPLs)**

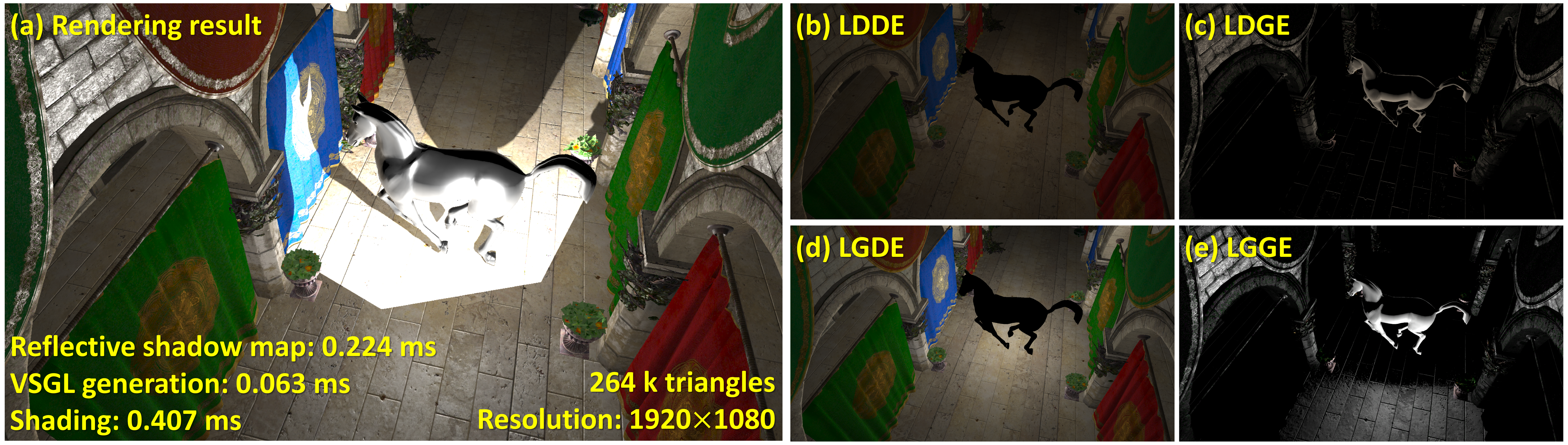



All-frequency indirect illumination can be represented with a smaller number of virtual lights which have an analytic formula of the rendering integral.

**Two VSGLs in this poster**




For acceleration, this poster employs only two VSGLs to represent secondary diffuse and specular bounces, respectively.




(GPU: AMD Radeon™ R9 290X)

**Decomposed images for each light path**

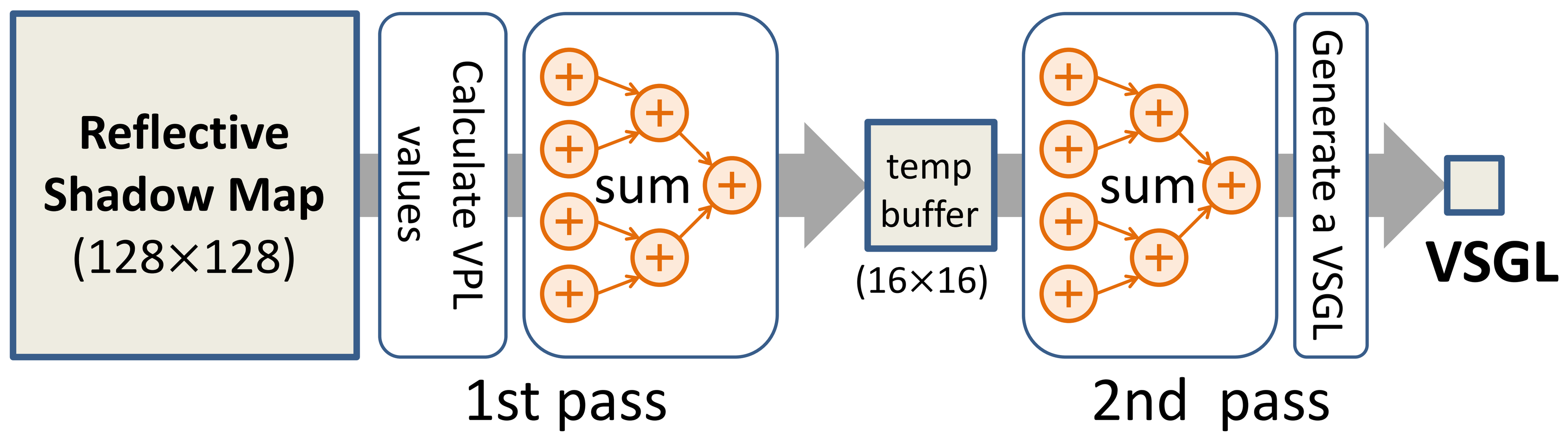
**Figure 1:** Rendering result using two VSGLs. Our method roughly approximates one-bounce glossy indirect illumination including **caustics (d)(e) without any high-frequency artifacts (e.g., flickering)**.

## 3. VSGL Generation

**Required values to compute VSGL parameters**

- Weighted avg. of VPL positions
- Weighted avg. of squared VPL positions (for variance)
- Weighted avg. of emission directions (for Toksvig filter)
- Total VPL power (i.e., total weight)

These values are calculated using a parallel summation algorithm on the GPU.




**VSGL generation using compute shaders for a 128×128 reflective shadow map (i.e., 16834 VPLs)**

## 4. Results

**Table 1:** Comparison with LPVs for the LDDE light path

| | VSGL | LPVs (32³ voxels x4 cascades) |
|---|---|---|
| Computation time | 0.492 ms | 2.232 ms |
| Memory usage | 204 kB | 1984 kB |

(699 k triangles scene, GPU: NVIDIA® GeForce® GTX™ 770)

As shown in Fig. 1, our method approximates indirect illumination including caustics in 0.7 ms. Table 1 shows comparison with cascaded light propagation volumes (LPVs) [Kaplanyan and Dachsbacher 2010]. Since LPVs are inefficient for highly glossy materials, only the LDDE light path is evaluated using a single VSGL. For this experiment, our method is faster and more memory saving than LPVs. Although rendering using so few VSGLs can be a rough approximation, its performance and visual quality are a practical level for scenes lit by a spot light.

**References**

Kaplanyan, A., and Dachsbacher, C. 2010. Cascaded light propagation volumes for real-time indirect illumination. In I3D'10, 99–107.

Tokuyoshi, Y. 2015. Virtual spherical Gaussian lights for real-time glossy indirect illumination. Comput. Graph. Forum 34, 7 (Pacific Graphics 2015).