



# Screen Space Lighting Approximation

## Motivating Problem

The rendering performance of illuminating with tens of thousands of light sources is inefficient.

## Related Works

- **Tiled shading**
  - Tile-based deferred shading
  - Light-culling and indexing [HARADA, Siggraph Asia 2012] [OLSSON, BILLETTER and ASSARSSON, HPG 2012]
- **Screen-space Approximation**  
HBAO [BAVOIL, SAINZ and DIMITROV, Siggraph 2008]
- **Geometry-aware Filters**  
Joint bilateral upsampling [KOPF, COHEN, LISCHINSKI and UYTENDAELE, TOG 2007]
- **Approximated indirect illumination**  
Splating illumination [NICHOLS and WYMAN, I3D 2009]

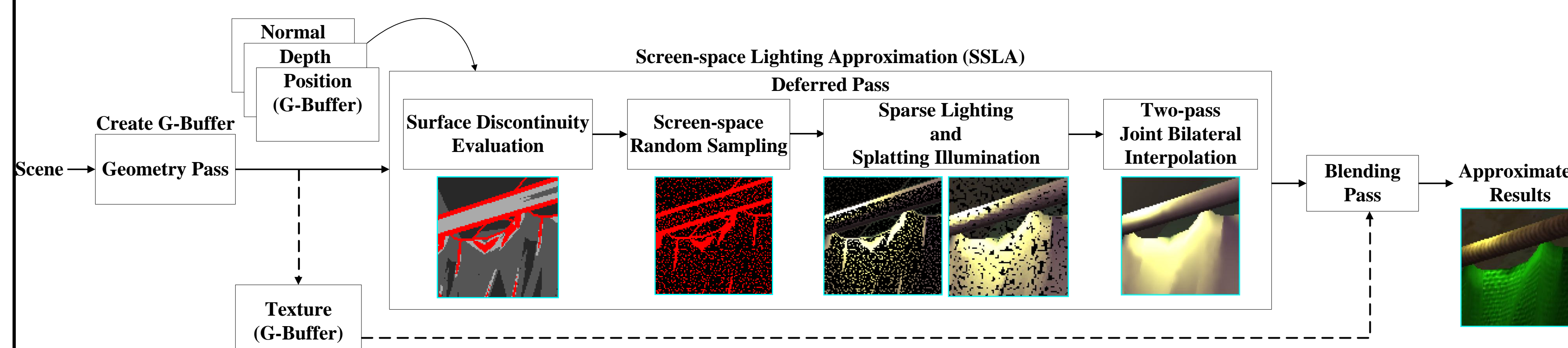
## Screen Space Lighting Approximation (SSLA)

- In the deferred pass,
  - Surface Discontinuity Evaluation
  - Screen-Space Random Sampling
  - Sparse Lighting and Splating Illumination
  - Two-pass Joint Bilateral Interpolation

## Rationale

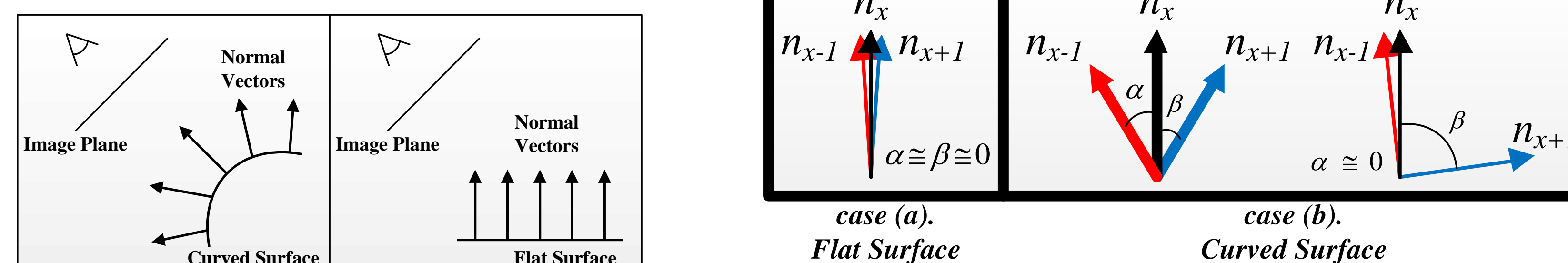
- Surface illuminations are locally smooth on the screen space.
- By lighting only this subset of screen pixels, we may reconstruct a fully illuminated result through interpolation (or upsampling).
- Computational complexity
  - Deferred shading –  $O(M \cdot N \cdot L)$
  - Tiled deferred shading –  $O(M \cdot N \cdot L_{\text{eff}})$
  - SSLA –  $O(\text{Pixel}_{\text{sampled}} \cdot L_{\text{eff}})$

## Algorithm Overview



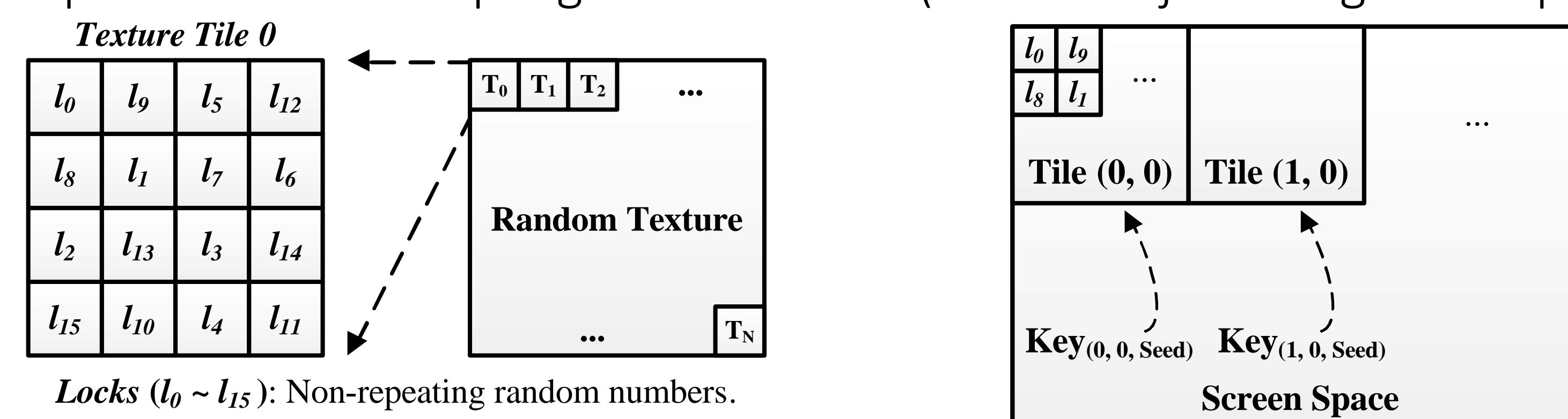
## Surface Discontinuity Evaluation

- Surface discontinuity detection  
Sobel filter operates on deferred depth texture.
- Geometric complexity  
Operate on deferred normal texture.



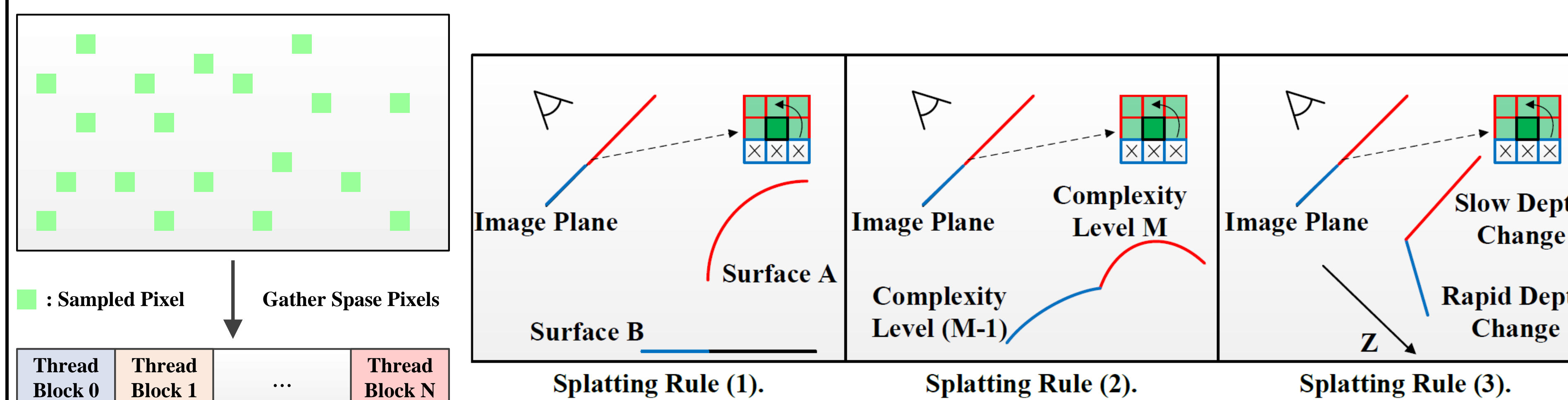
## Screen-Space Random Sampling

- Screen-space random sampling in tile fashion (similar to jittered grid sampling)



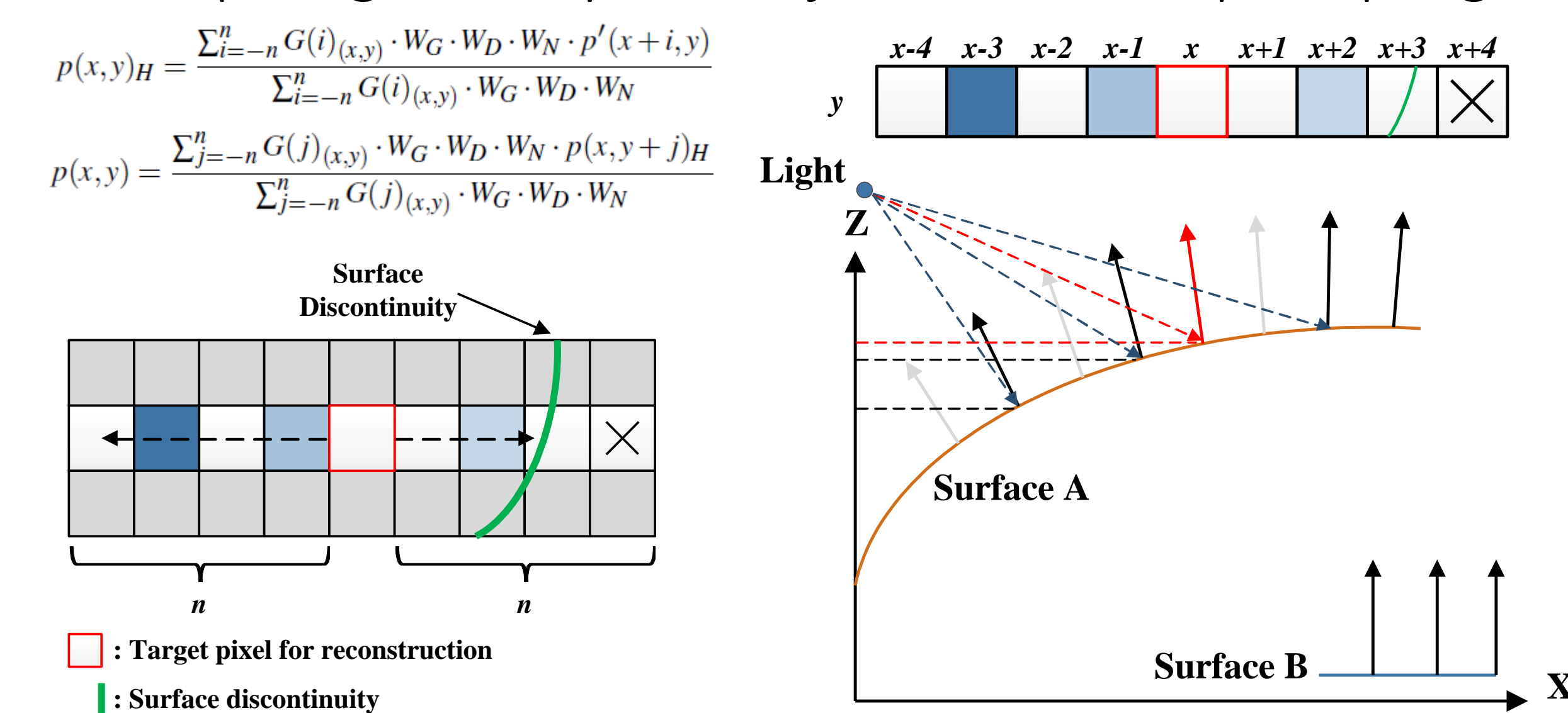
## Sparse Lighting and Splating Illumination

- Batching sparse sampled pixels into batched threads
- Splat illumination considering geometric constraints



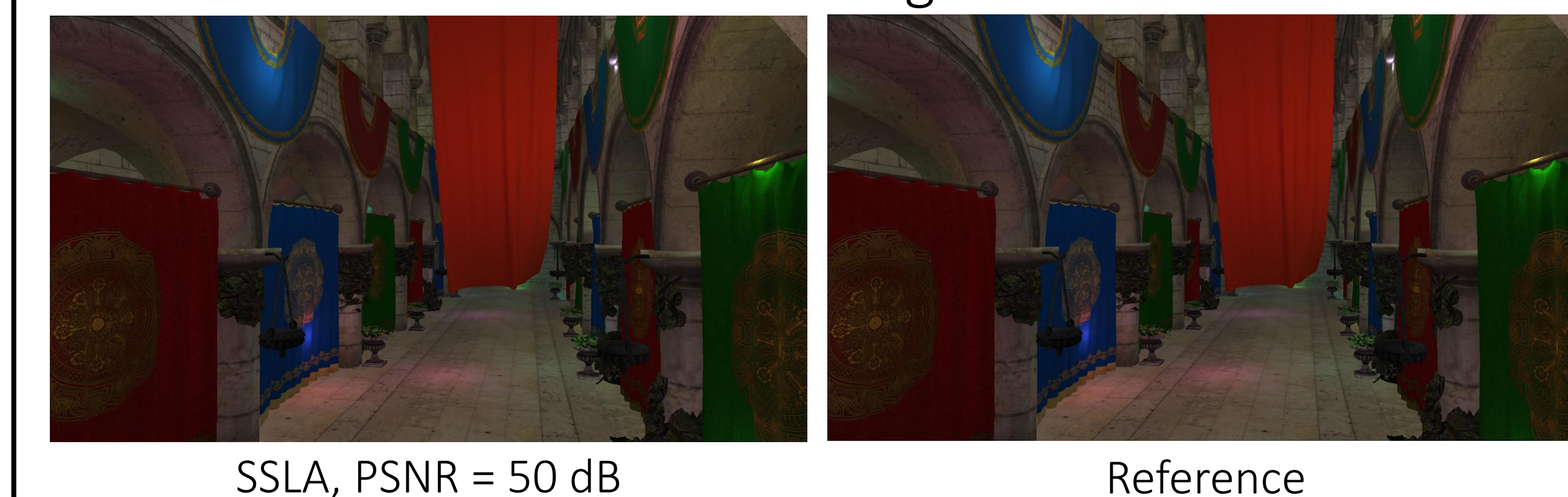
## Two-pass Joint Bilateral Interpolation

- Two-pass geometry-aware joint bilateral upsampling



## Results

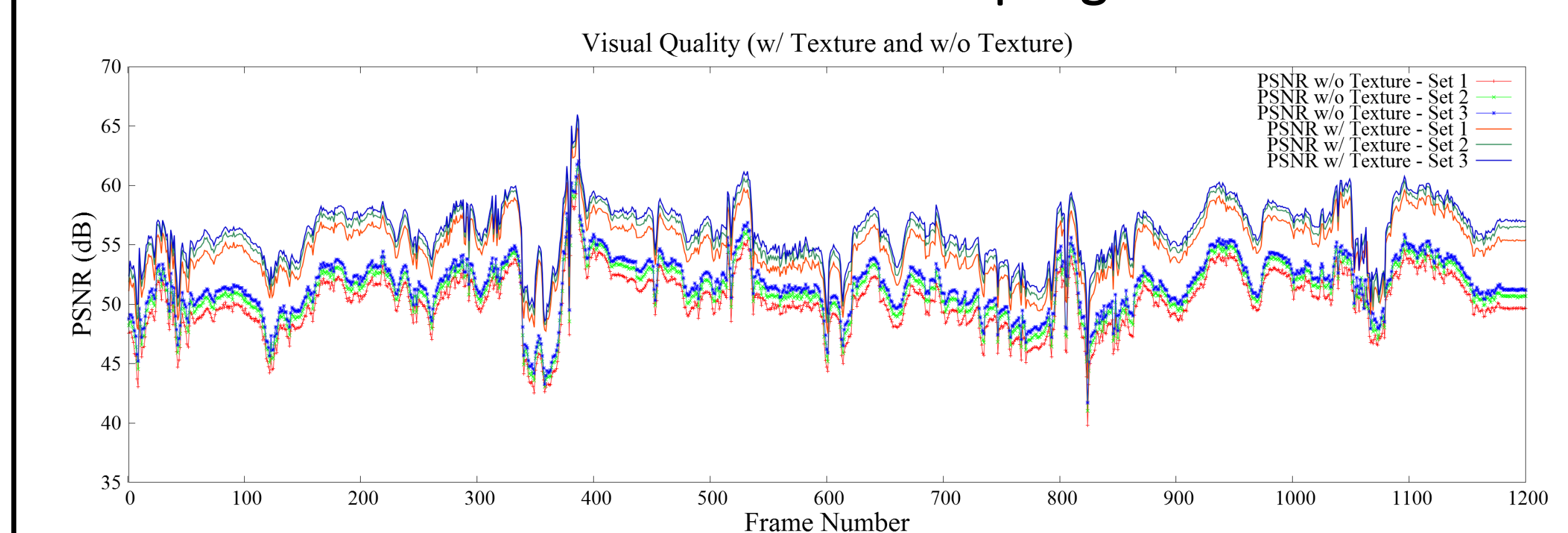
- Evaluation is done under 1K lights case.



Evaluation on bumpy surface



Evaluation on sets of sampling rate



Evaluation on each operation

