CS482:
Point based Approach

Sung-Eui Yoon
(윤성의)

Course URL:
http://sglab.kaist.ac.kr/~sungeui/ICG

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Project Guidelines: Project Topics

- **Any topics related to the course theme are okay**
  - **You can find topics by browsing recent papers**
- **You can bring your own research to the class, only if it is related to the course theme**
  - **You need to get a permission from me for this**

Expectations

- **Mid-term project presentation**
  - **Introduce problems and explain why it is important**
  - **Give an overall idea on the related work**
  - **Explain what problems those existing techniques have**
  - **(Optional) explain how you can address those problems**
  - **Explain roles of each member**

Expectations

- **Final-term project presentation**
  - **Cover all the materials that you talked for your mid-term project**
  - **Present your ideas that can address problems of those state-of-the-art techniques**
  - **Give your qualitatively (or intuitive) reasons how your ideas address them**
  - **Also, explain expected benefits and drawbacks of your approach**
  - **(Optional) backup your claims with quantitative results collected by some implementations**
  - **Explain roles of each members**

A few more comments

- **Start to implement a paper, if you don't have any clear ideas**
  - **While you implement it, you may get ideas about improving it**

Final-project evaluation sheet

You name:
ID:

Score table: higher score is better.

Speaker	Novelty of the project and idea (1 ~ 5)	Practical benefits of the method (1 ~ 5)	Completeness level of the project (1 ~ 5)	Total score (3 ~ 15)	Role of each student is clear and well balanced? (Yes or No)
XXX					
YYY					

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Class Objective

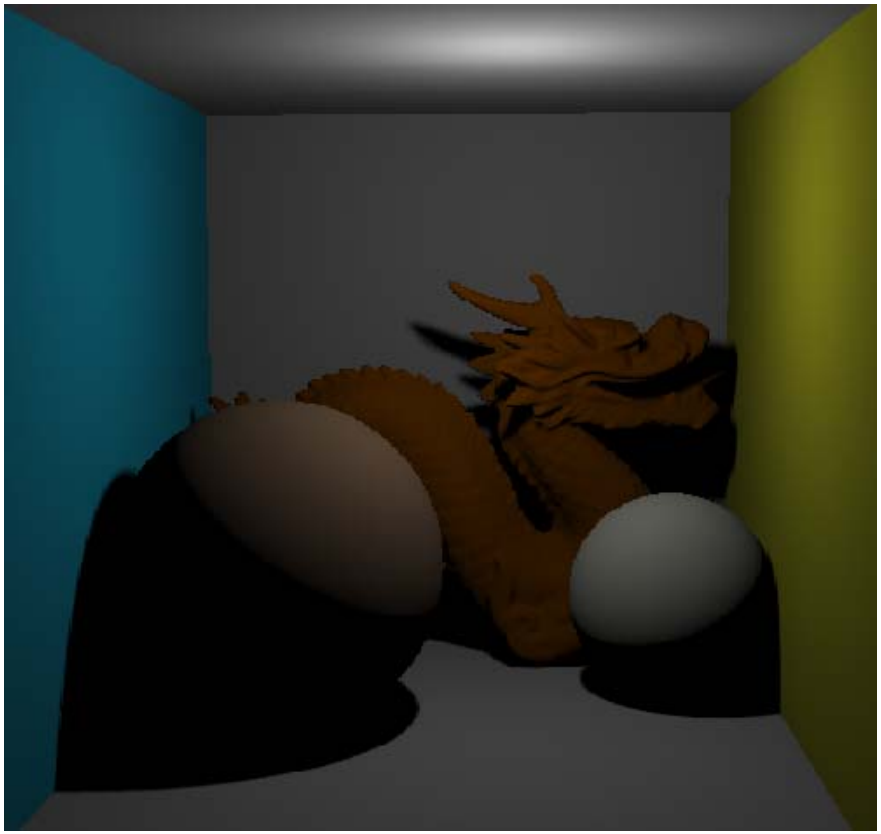
- **Get to know a recent point-based rendering as an approximation method**
  - **Use a small shadow map, micro framebuffer**
  - **Use point clouds for computing such shadow maps**

Micro-Rendering for Scalable, Parallel Final Gathering

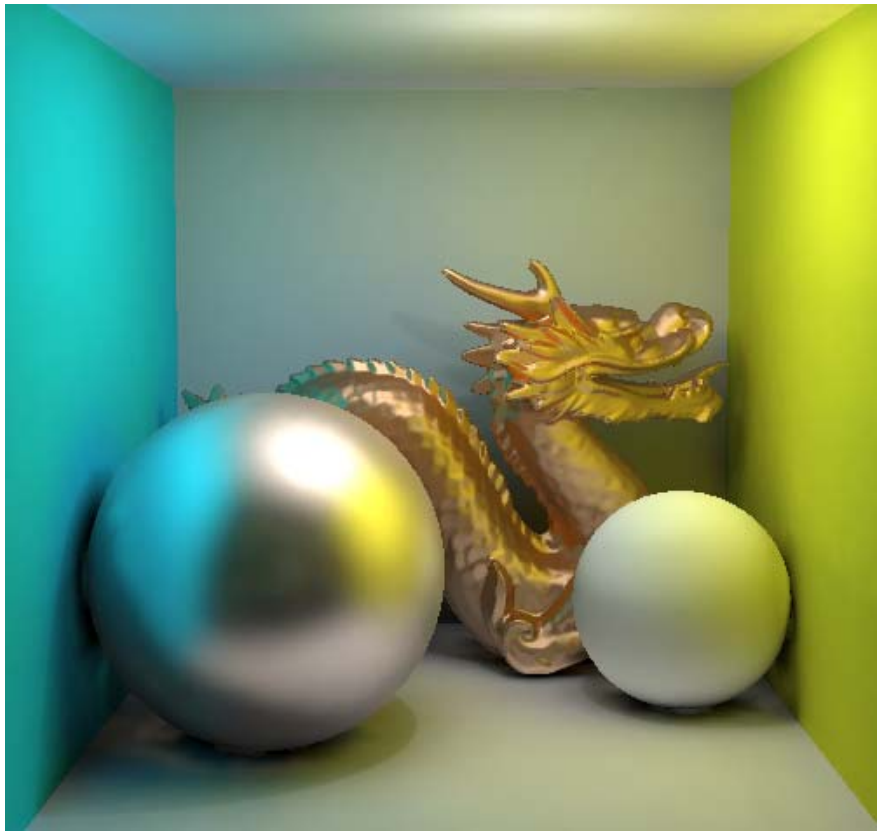
Tobias Ritschel et al.

Modified from authors‘ slides

Without global illumination

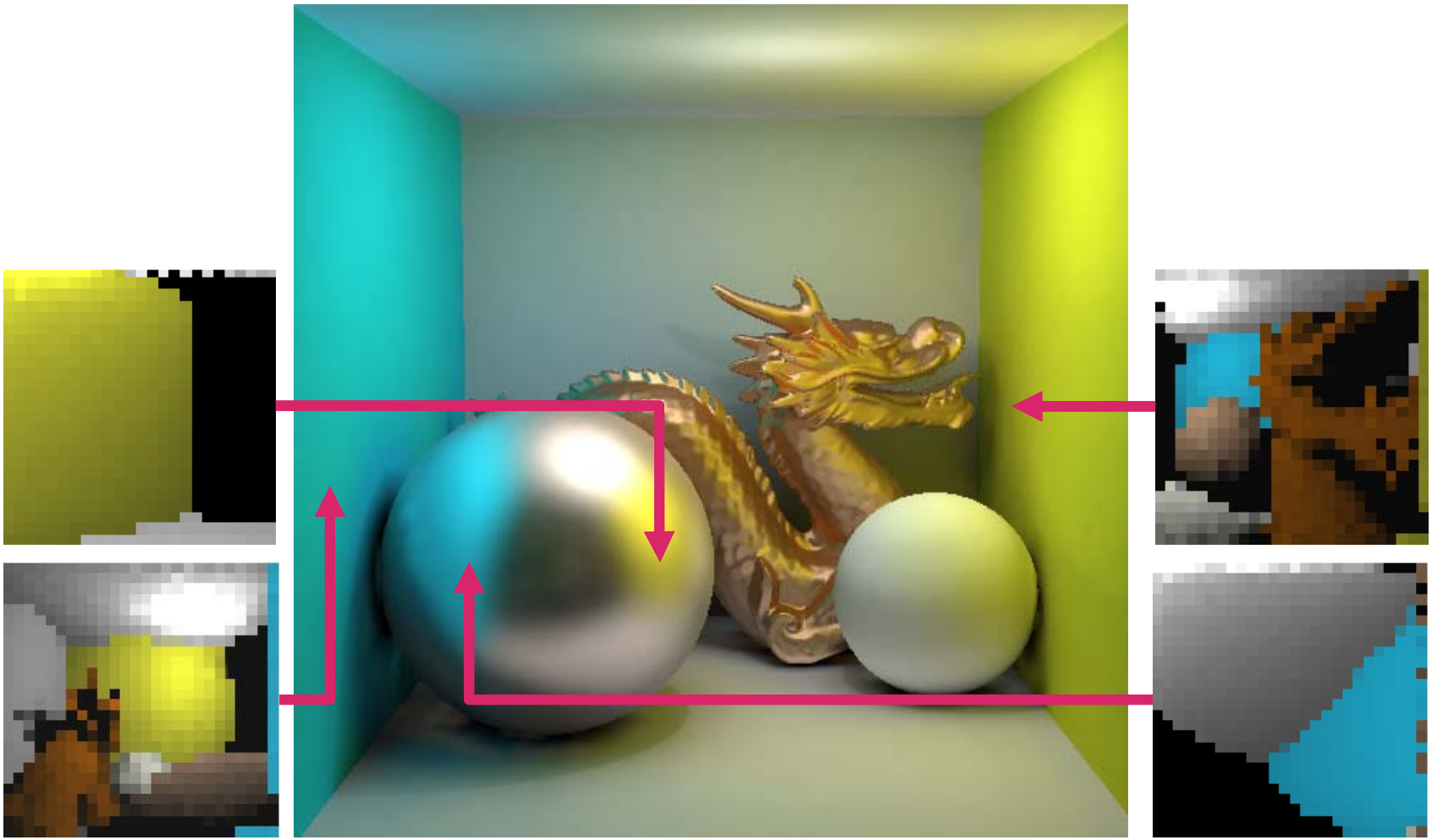


With global illumination



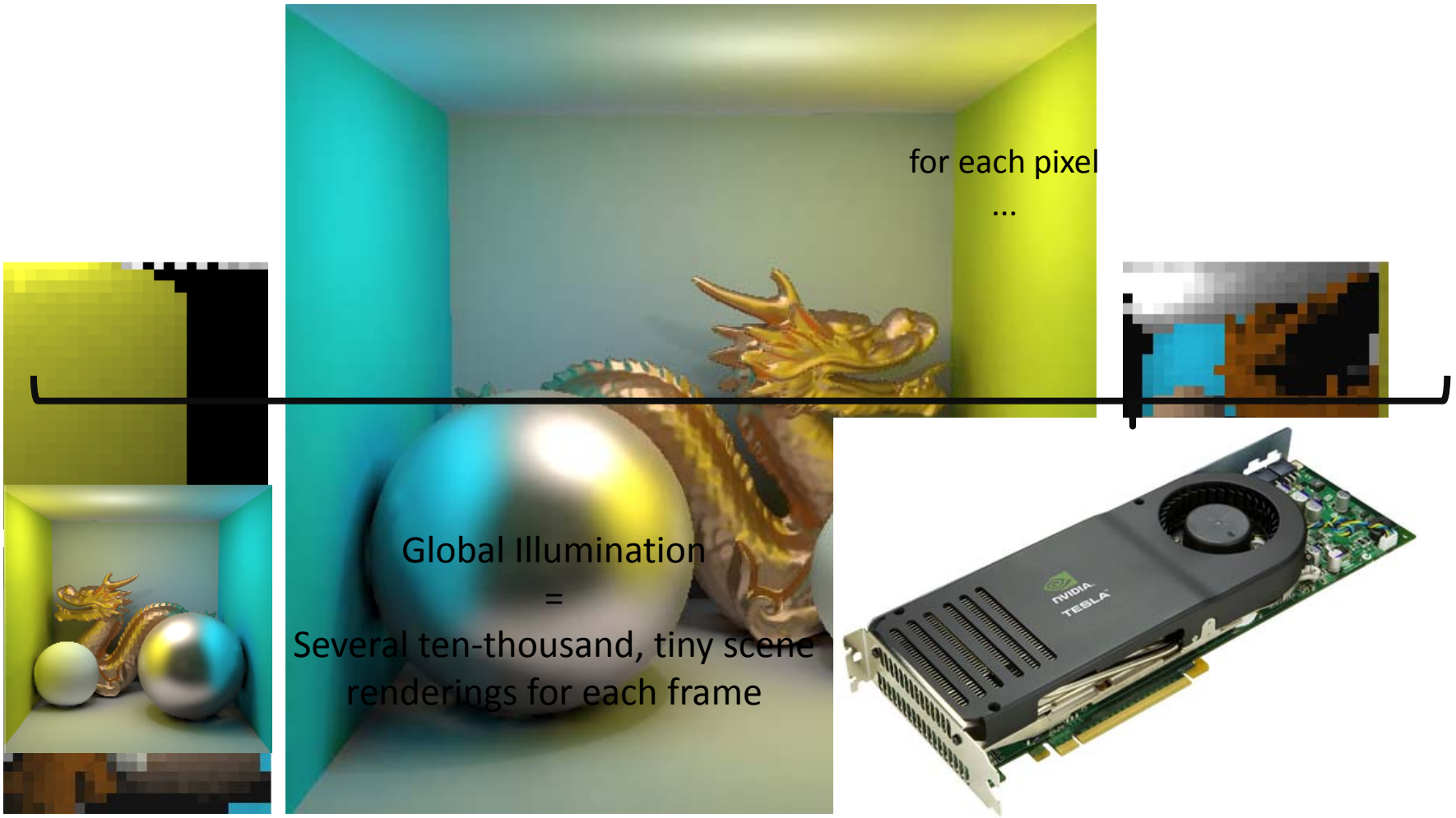
MOTIVATION

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

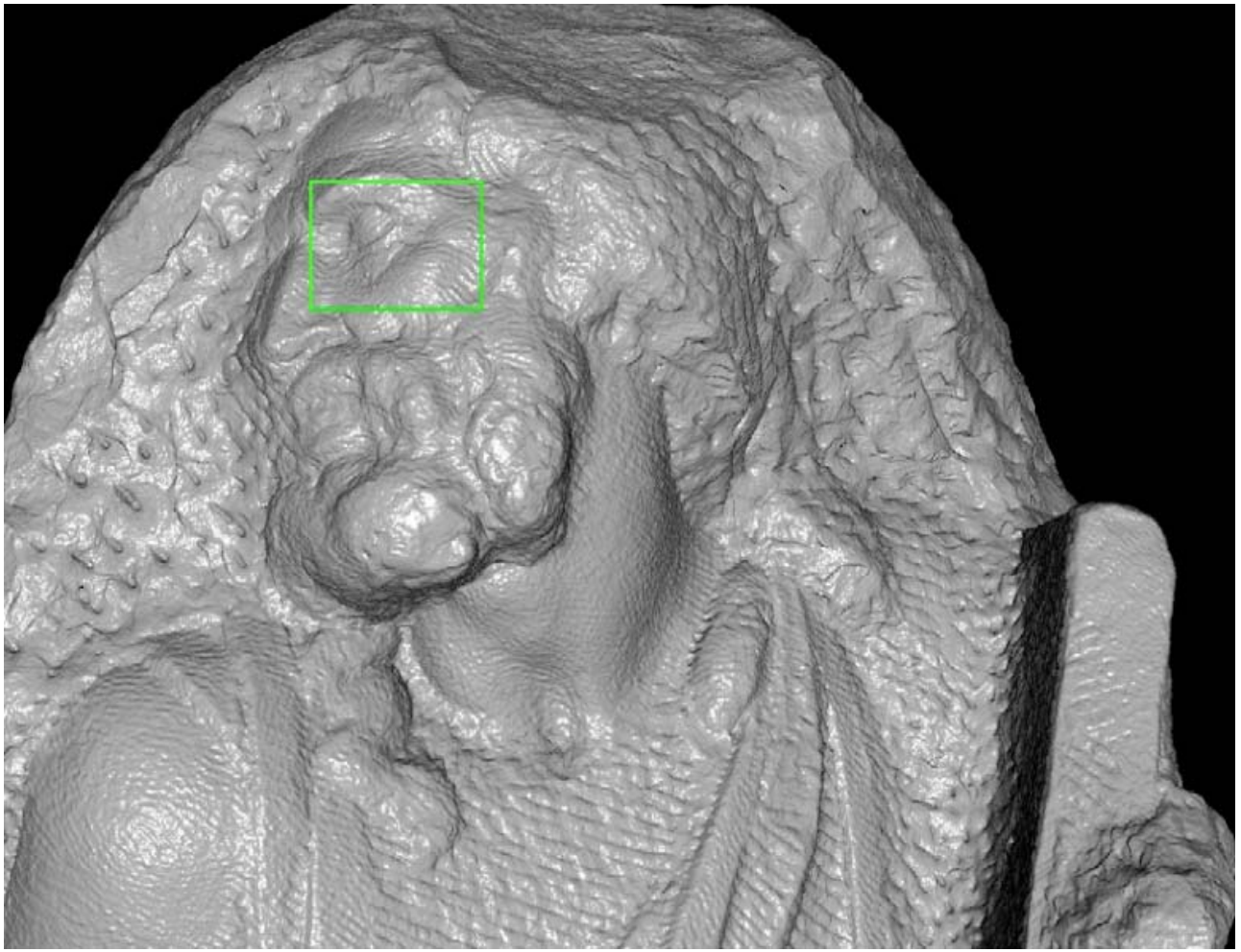


IDEA

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)



A TRANSPOSED PIPELINE

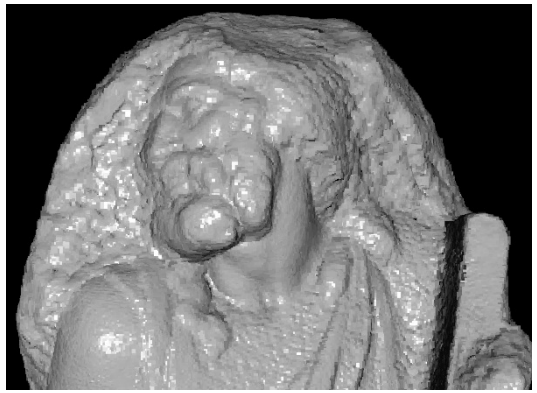


Szymon Rusinkiewicz and Marc Levoy:
QSplat: A Multiresolution Point Rendering System for Large Meshes
SIGGRAPH 2001

Michelangelo:
St. Mathew (*unfinished*)
Before 1501

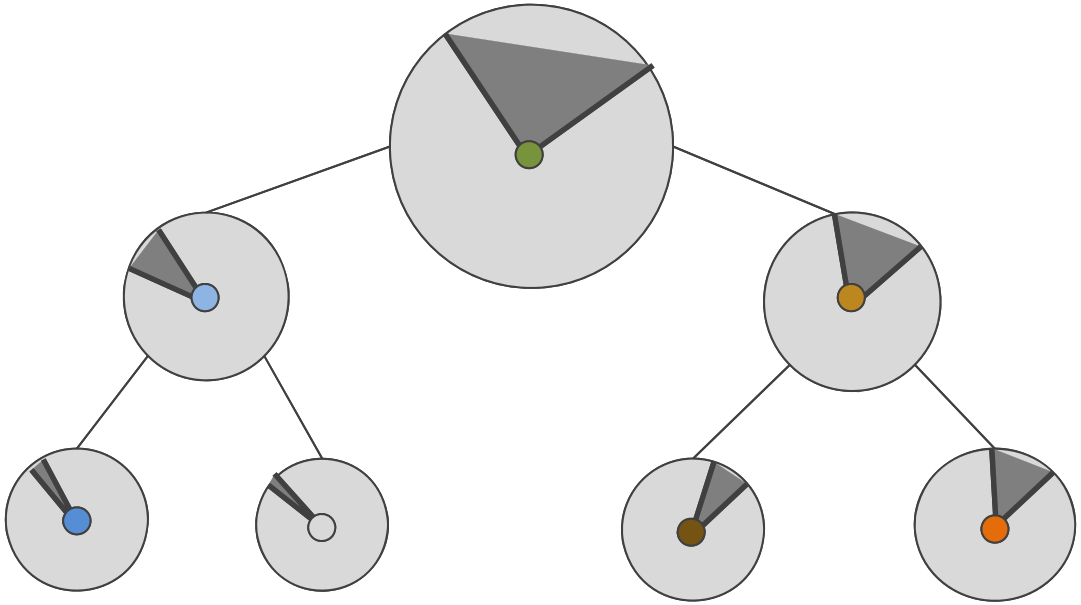
Q-SPLAT

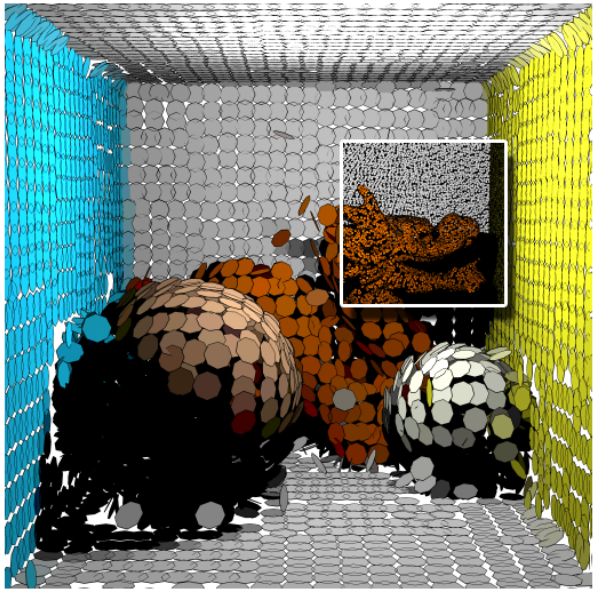
Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

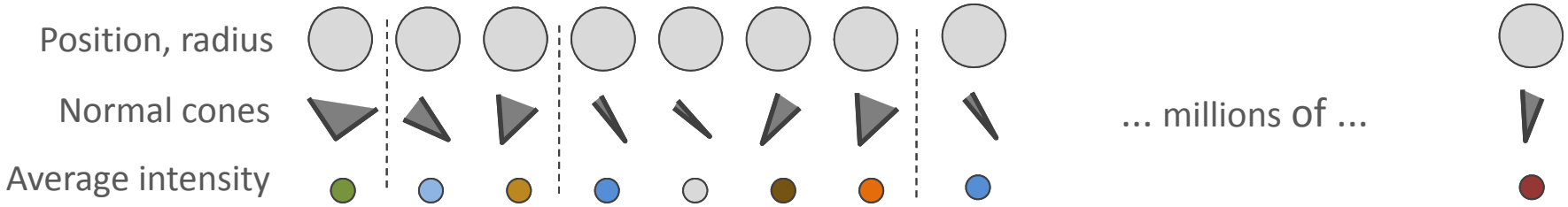


Q-SPLAT

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

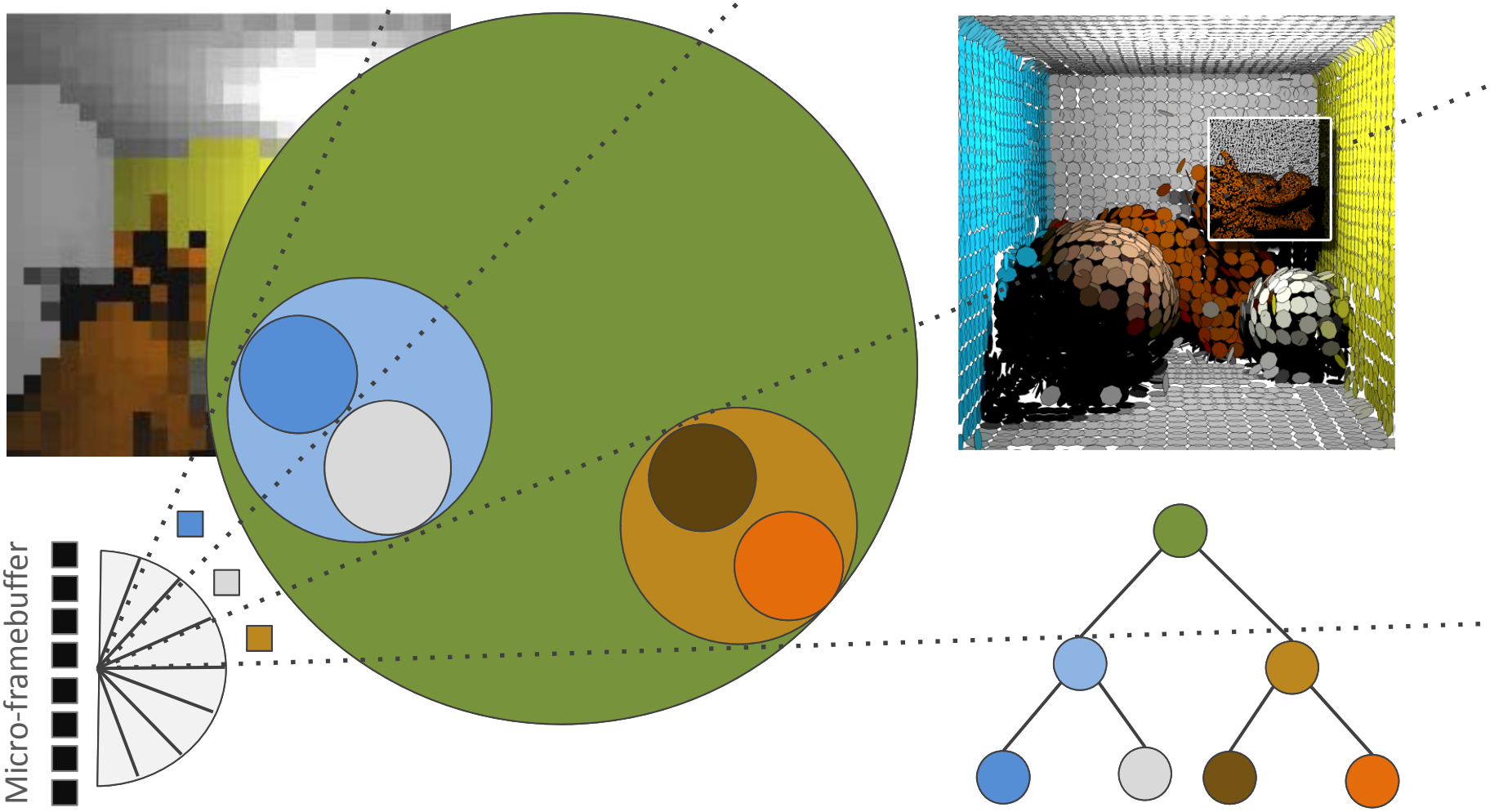






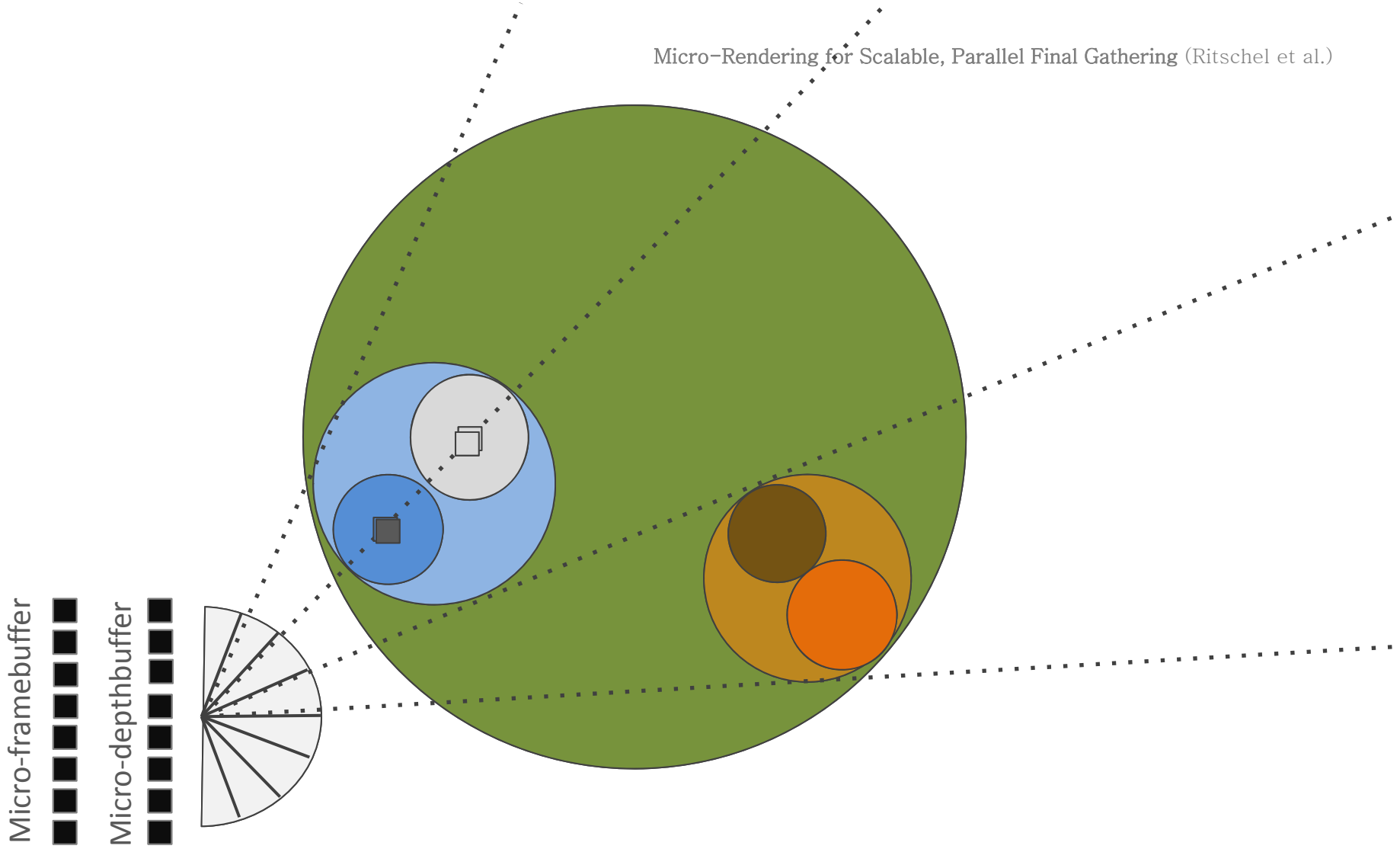
TREE REPRESENTATION

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

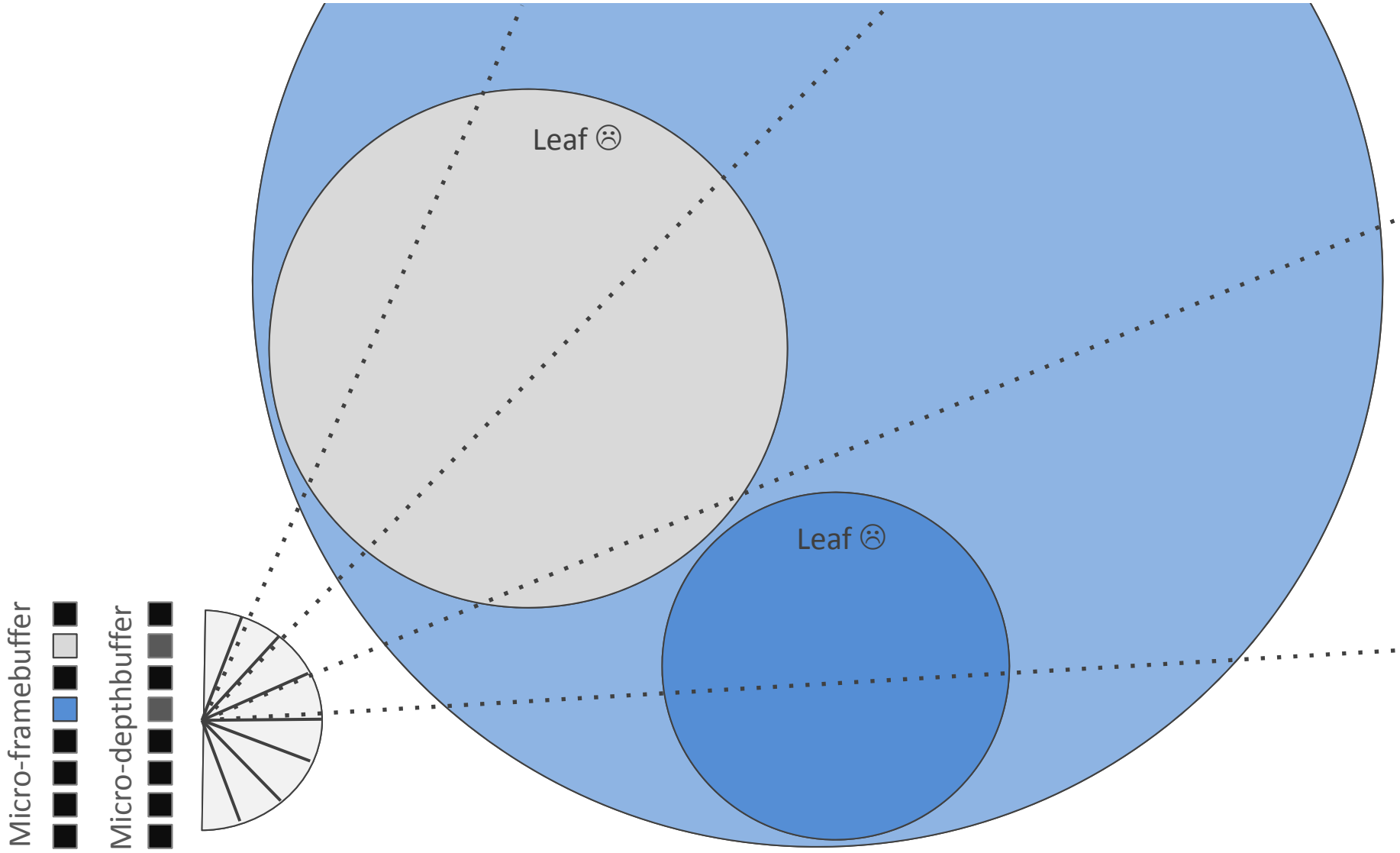


Q-SPLAT GATHERING

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)



Q-SPLAT GATHERING

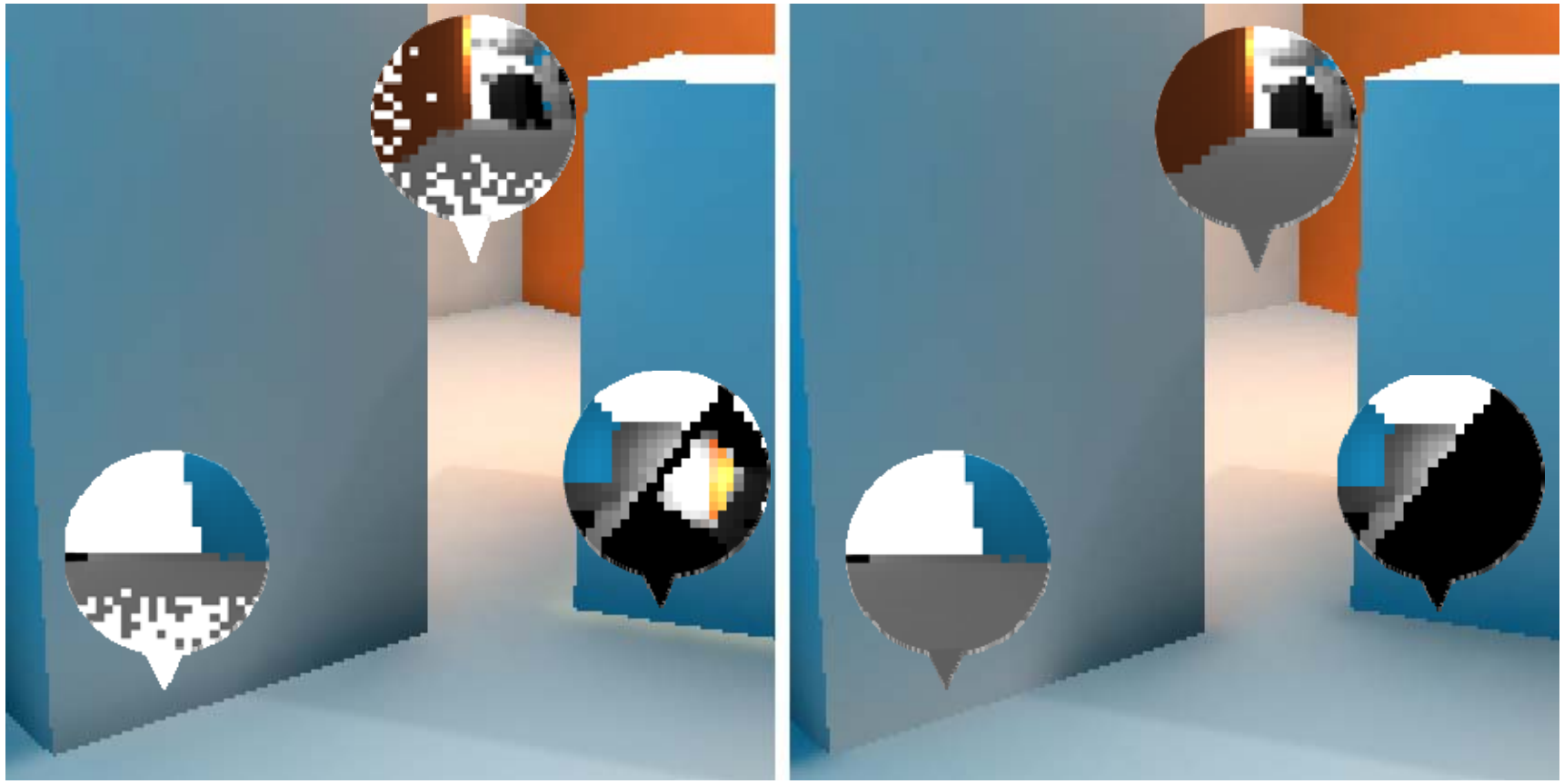


PREVENTING HOLES

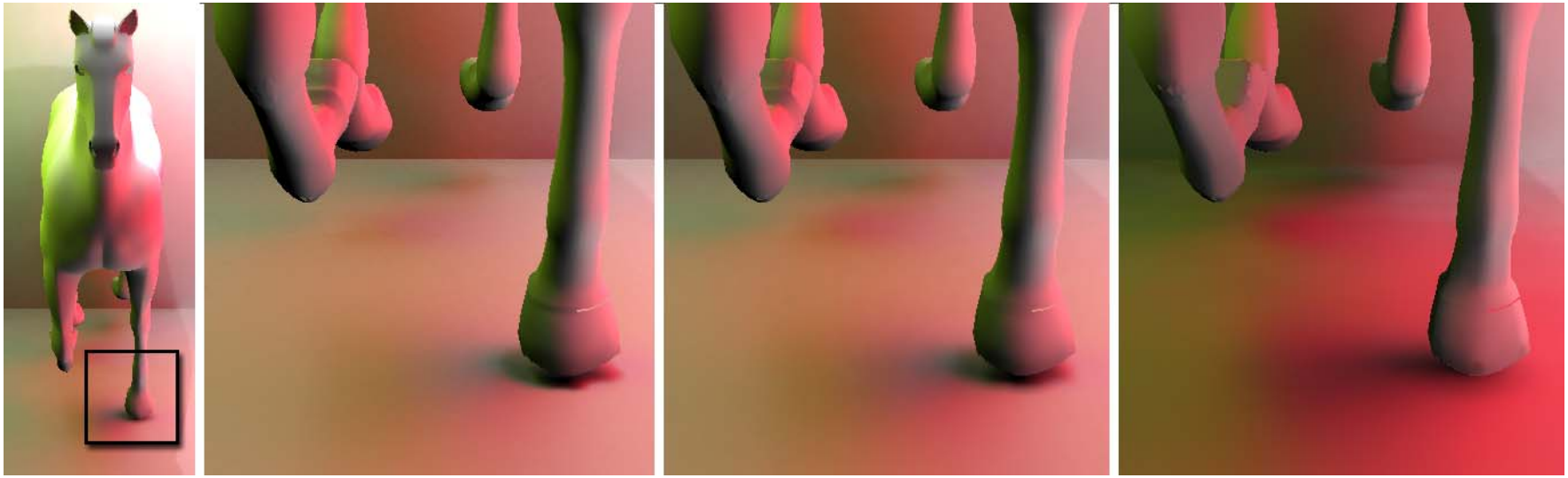
Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

Without ray-casting

With ray-casting



PREVENTING HOLES



24x24
0.7 frames / second

16x16
1.5 frames / second

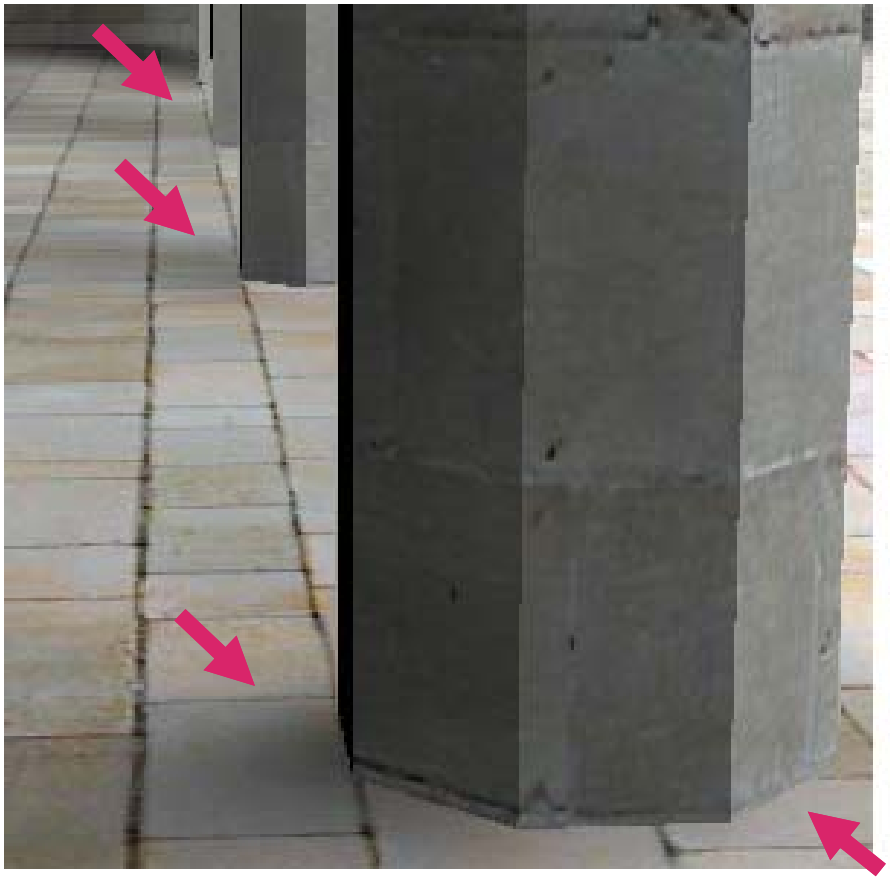
8x8
3.2 frames / second

Resolution of micro framebuffer

SCALABILITY: OCCLUSION

Ritschel et al.: Imperfect Shadow Maps (*Previous*)
SIGGRAPH Asia 2008

5 frames / second

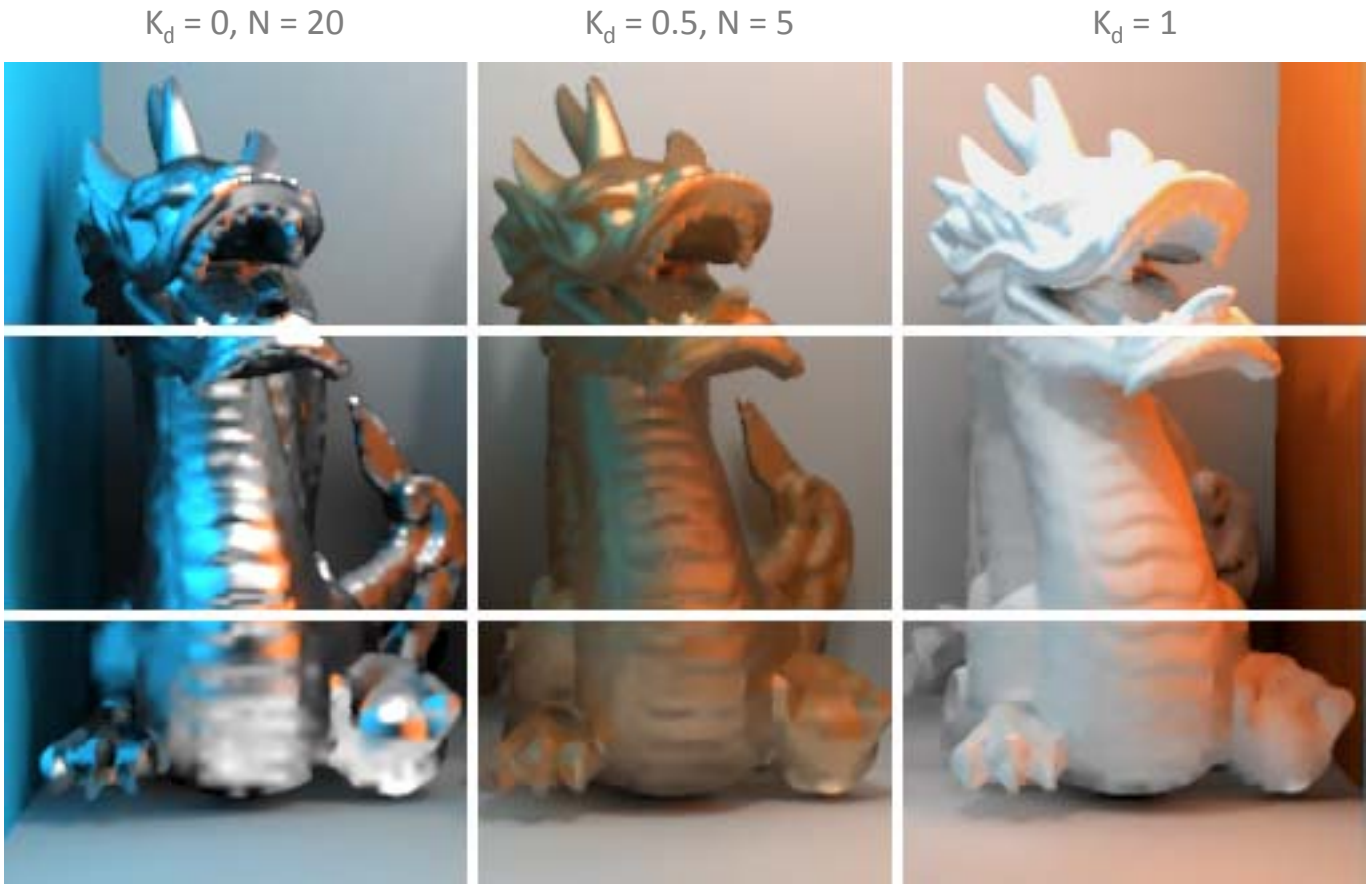


Ritschel et al.: Micro-Rendering (*Ours*)
SIGGRAPH Asia 2009

5 frames / second

VS. IMPERFECT SHADOW MAPS

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)



Bilateral upsampling

SCALABILITY: MATERIALS

Gaussian Filter

- **Results in smooth images, but destroy edge information**

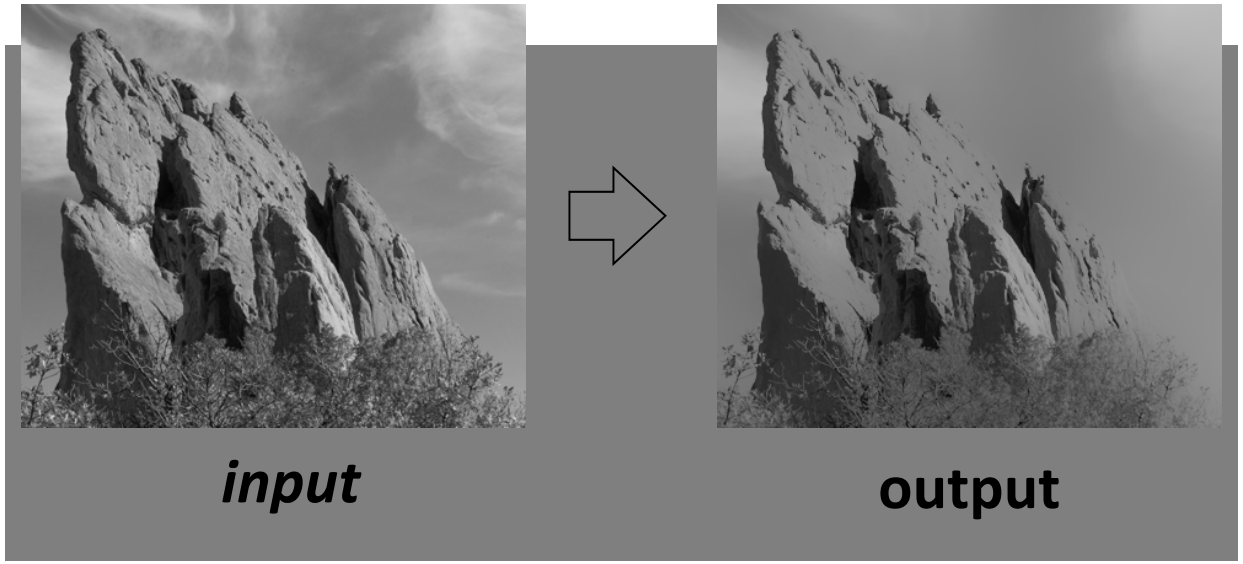


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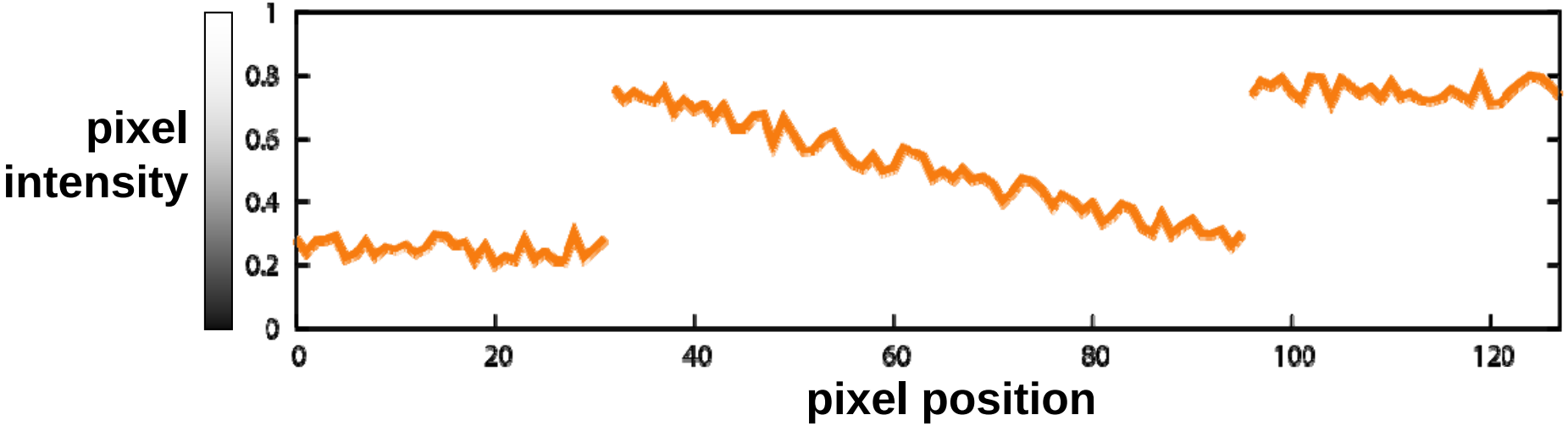
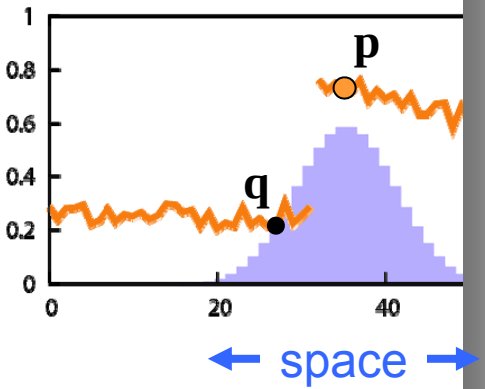
Illustration a 1D Image

- 1D image = line of pixels

- Better visualized as a plot



Definition

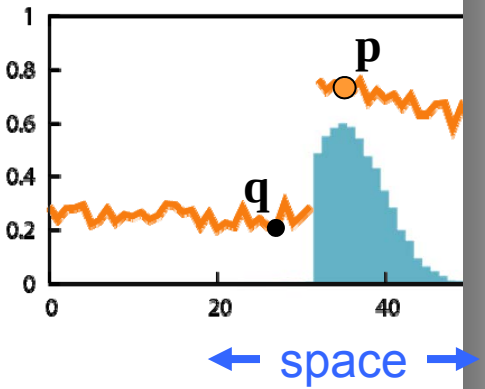


Gaussian blur

$$I_{\mathbf{p}}^{\mathrm{b}} = \sum_{\mathbf{q}\in\mathcal{S}} G_{\sigma_{\mathrm{s}}}(\|\mathbf{p}-\mathbf{q}\|)\, I_{\mathbf{q}}$$

space

- only spatial distance, intensity ignored



range

Bilateral filter

[Aurich 95, Smith 97, Tomasi 98]

$$I_{\mathbf{p}}^{\mathrm{bf}} = \frac{1}{W_{\mathbf{p}}^{\mathrm{bf}}} \sum_{\mathbf{q}\in\mathcal{S}} G_{\sigma_{\mathrm{s}}}(\|\mathbf{p}-\mathbf{q}\|)\, G_{\sigma_{\mathrm{r}}}(|I_{\mathbf{p}}-I_{\mathbf{q}}|)\, I_{\mathbf{q}}$$

normalization space range

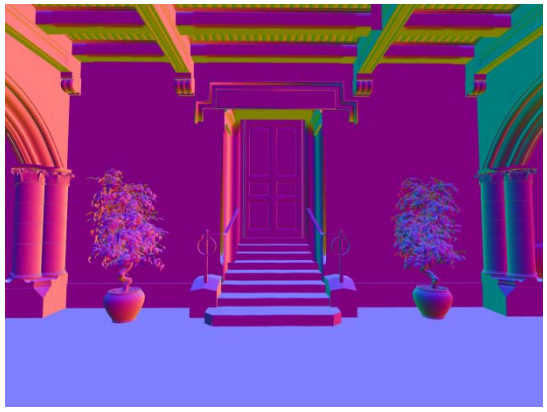
- spatial and range distances
- weights sum to 1

G-Buffers

- Contain various geometric features and uses them as edge-stopping functions

Input

Textures



Normals

Micro-Rendering for Scalable, Parallel Final Gathering (Ritschel et al.)

No Bounce

1 Bounce
10 frames / second

2 Bounces
5 frames / second

MULTIPLE BOUNCES

CONCLUSION

Microrendering computes final **gathering** for **large** and **dynamic** scenes with **glossy** materials in **parallel**

FUTURE WORK

1. Complex deformations result in an in efficient tree
   ... *a body of work existst for ray-tracing*
2. Adaptivity in screen space
   ... *also a body of work for radiance and irradiance caching*
3. Reduce local memory footprint
   ... *we think we will get it down by an order of magnitude*

Class Objective were:

- Get to know a recent point-based rendering as an approximation method
  - Use a small shadow map, micro framebuffer
  - Use point clouds for computing such shadow maps

Any Questions and HWs

- **Come up with one question on what we have discussed in the class and submit at the end of the class**
  - **Submit four times in Sep./Oct.**
  - **1 for typical questions**
  - **2 for questions that have some thoughts or surprise me**
- **Go over the next lecture slides before the class**
- **Watch 2 SIG/I3D/HPG videos and submit your summaries every Tue. class**

Next Time

- **Handling difficult light paths**

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