A Layered Depth-of-Field Method for Solving Partial Occlusion

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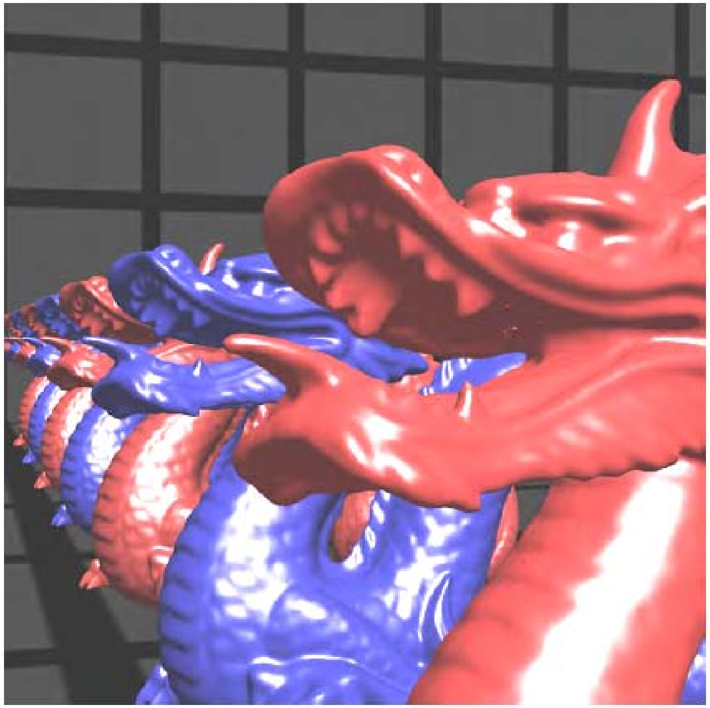
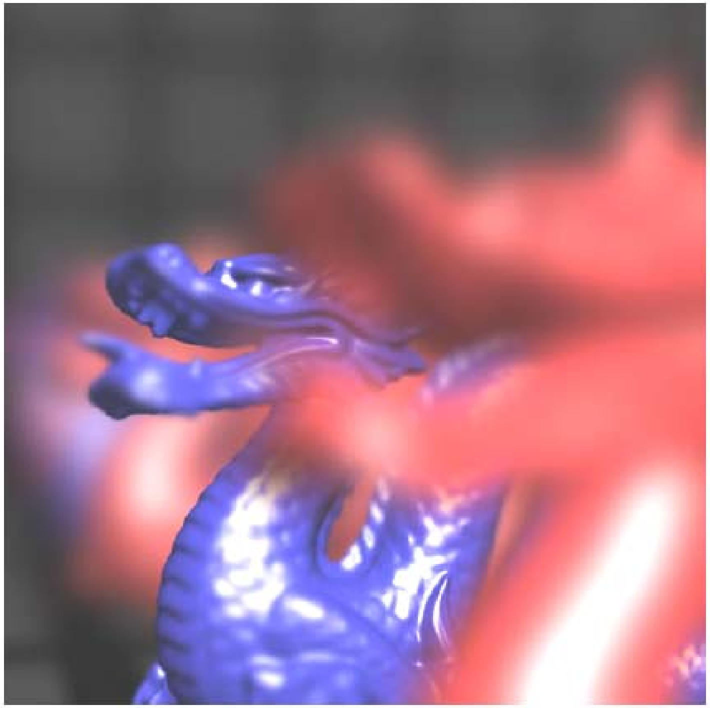
Real life partial occlusion

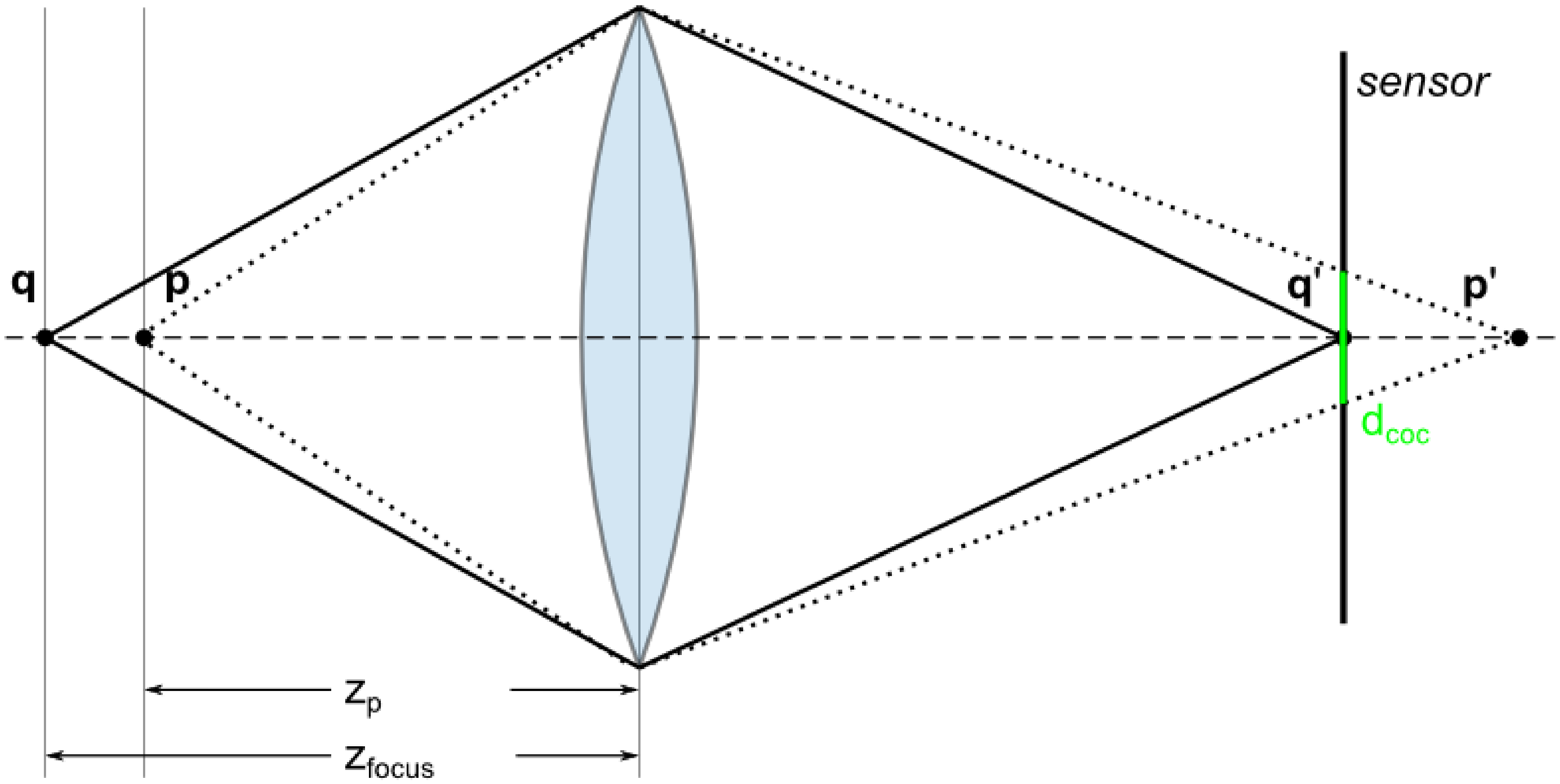
Intro/Overview

- depth-of-field approximation
  - post processing
  - partial occlusion in realtime





Thin lens

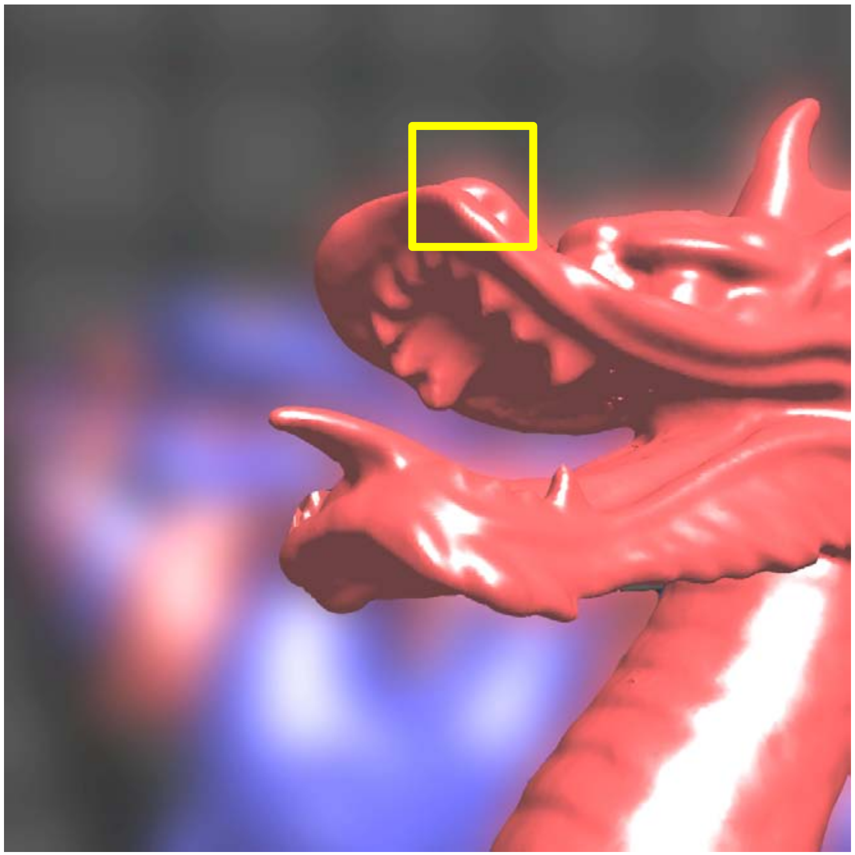


Previous work

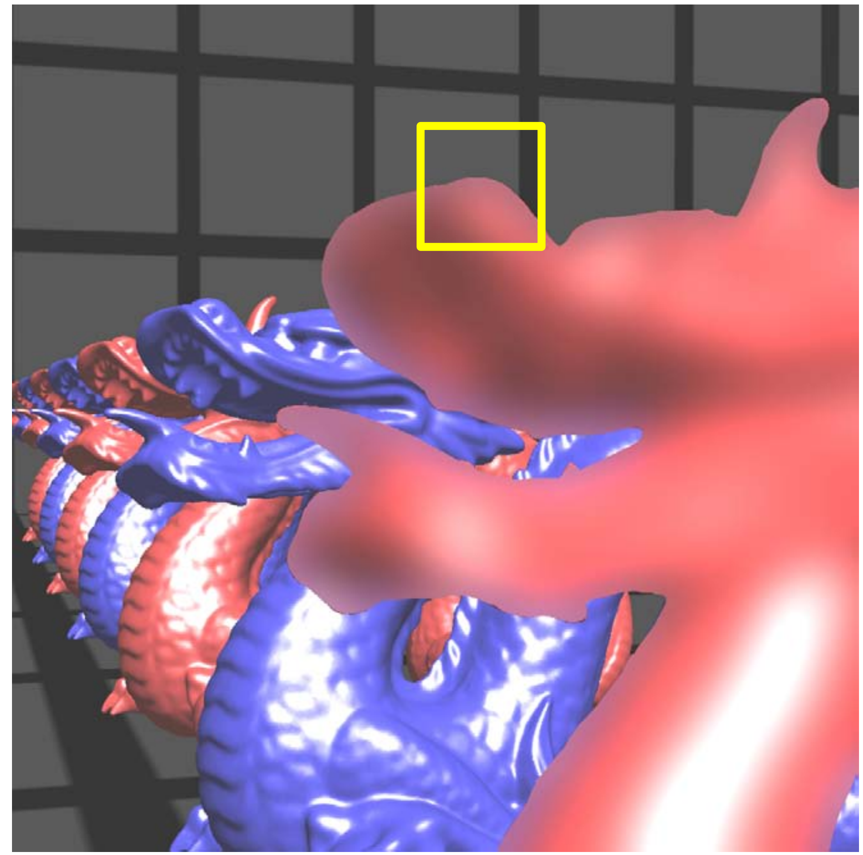
- Potmesil and Chakravarty, 1981
  - CoC - equation
  - first post-processing method
  - blur according to CoCs
  - still a reference
  - artifacts

Artifacts

- color bleeding:

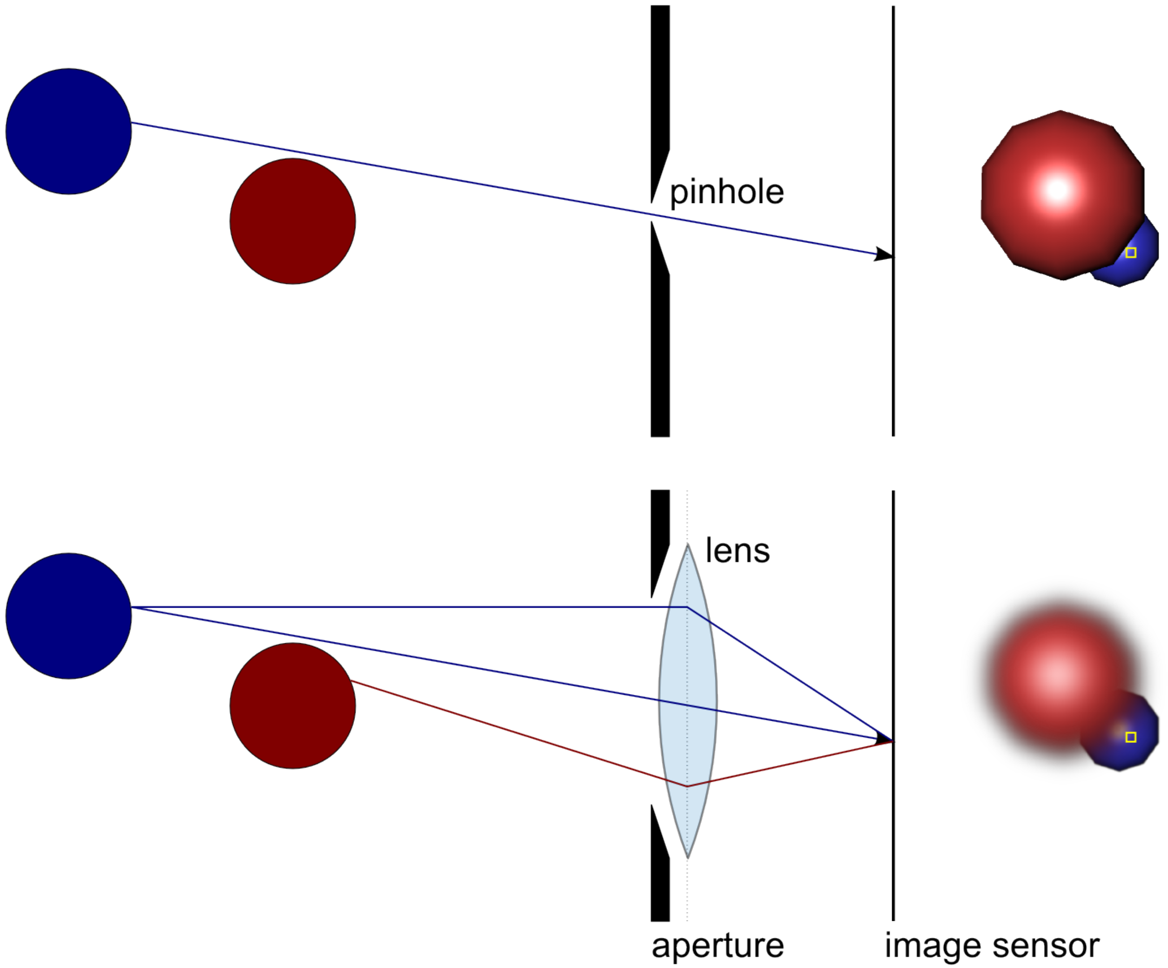


- depth discontinuity:



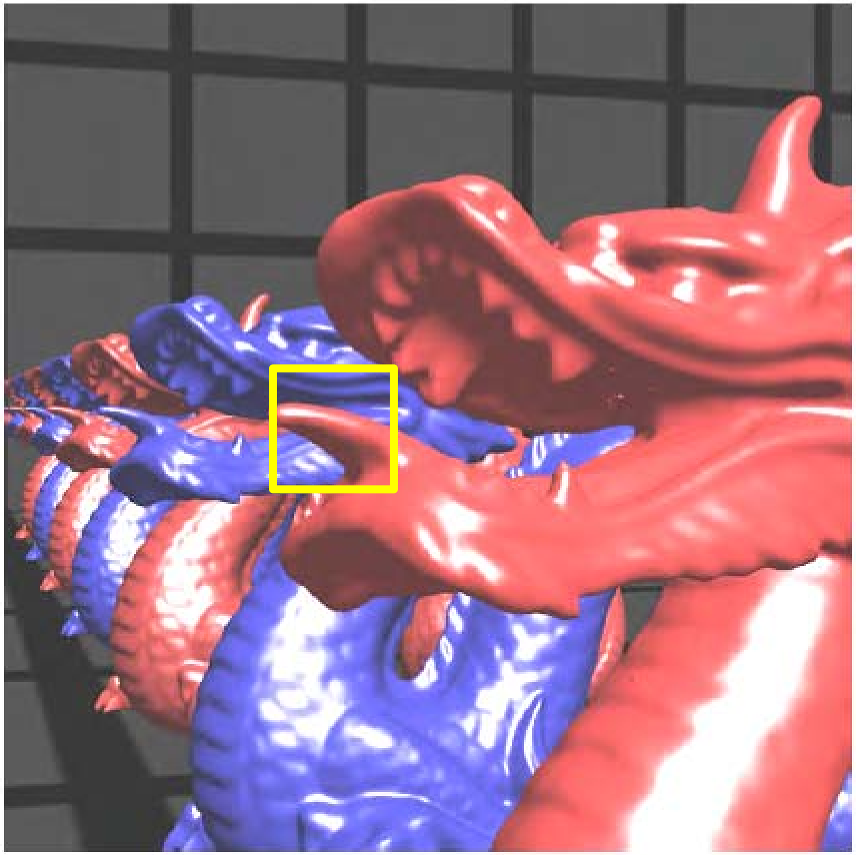
Partial Occlusion

- pinhole vs. finite aperture

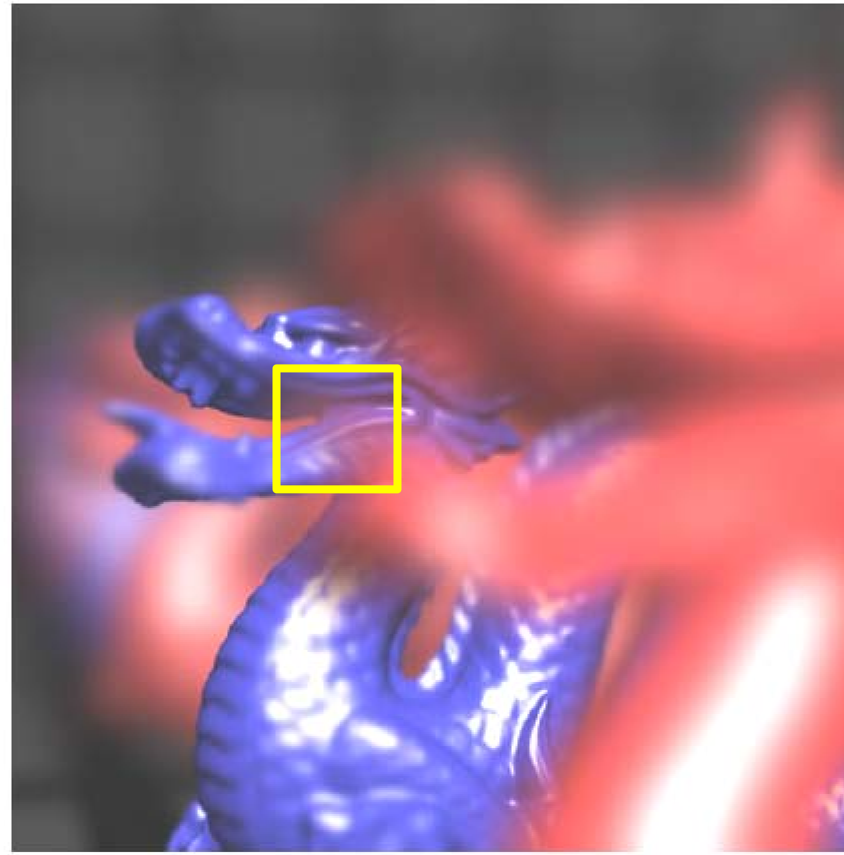


Partial Occlusion

- pinhole:



- finite aperture:

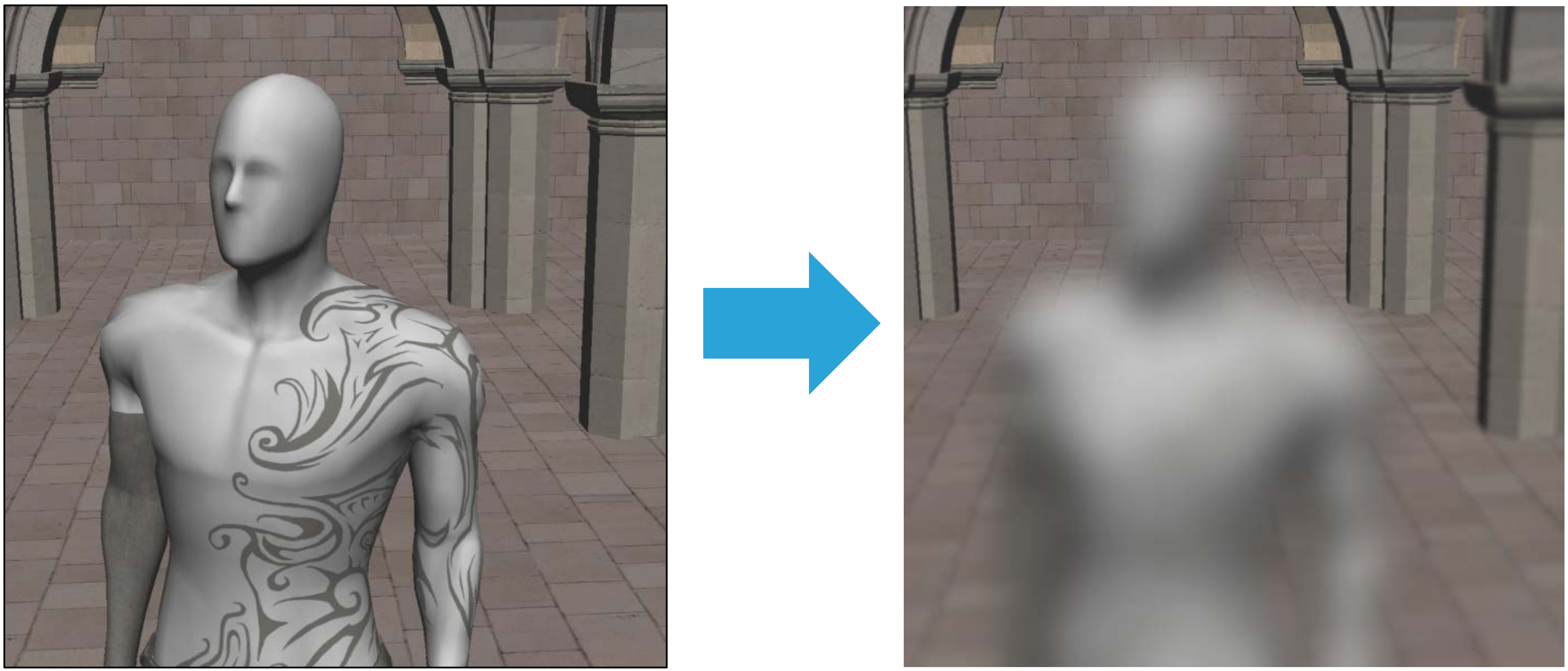


Previous work – solve partial occlusion

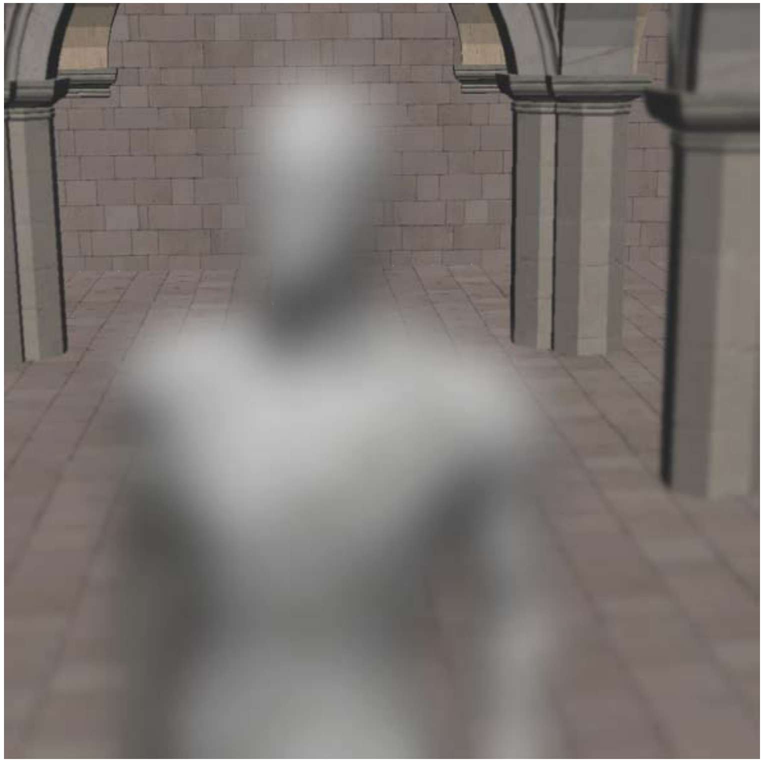
- non-realtime:
  - ray-tracing (Cook et al., 1984)
  - Accumulation B. (Haeberli and Akeley, 1990)

- layered methods:
  - Kraus and Strengert, 2007
    - occluded scene content only interpolated
  - Lee et al., 2010
    - image composition via ray traversal
    - simulate more lens effects
    - more complex and slower than ours

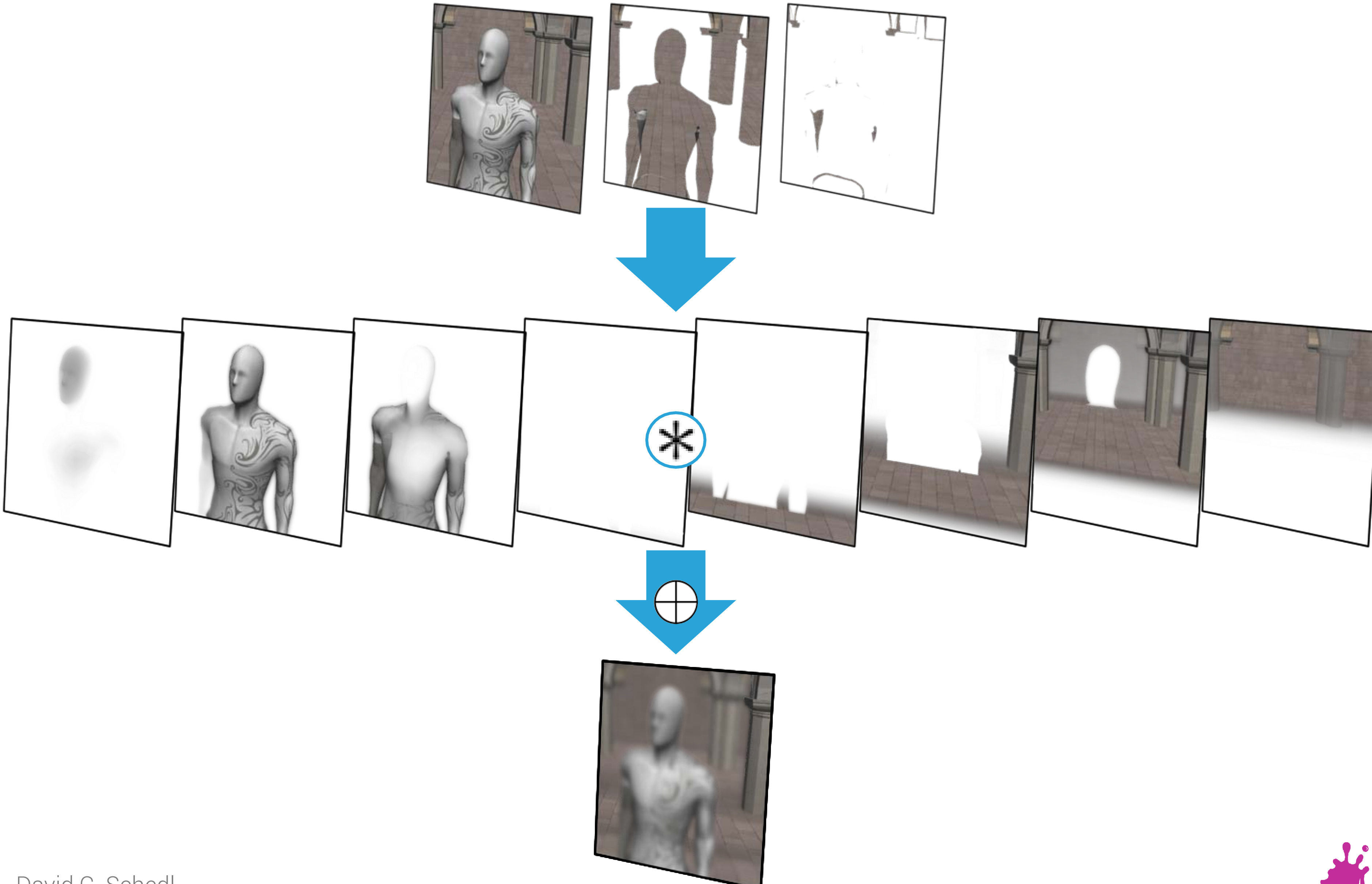
Our Method



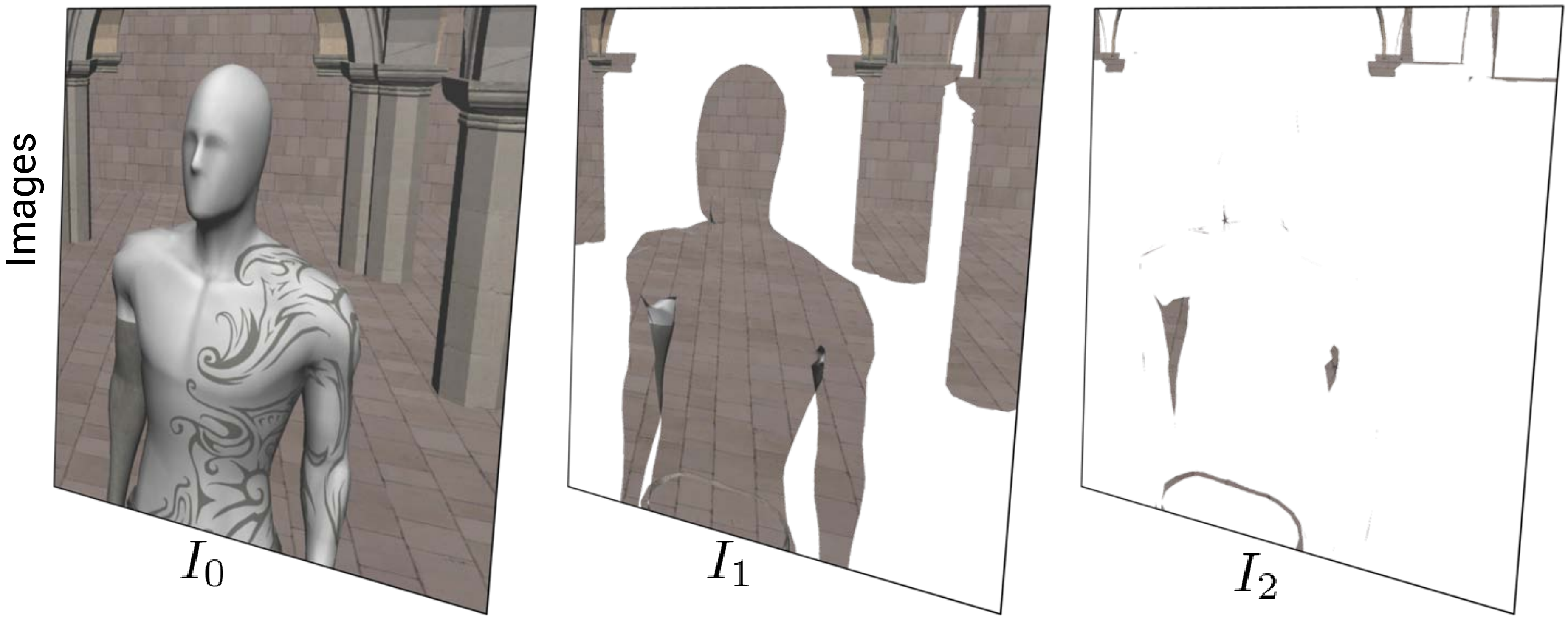
Our Method



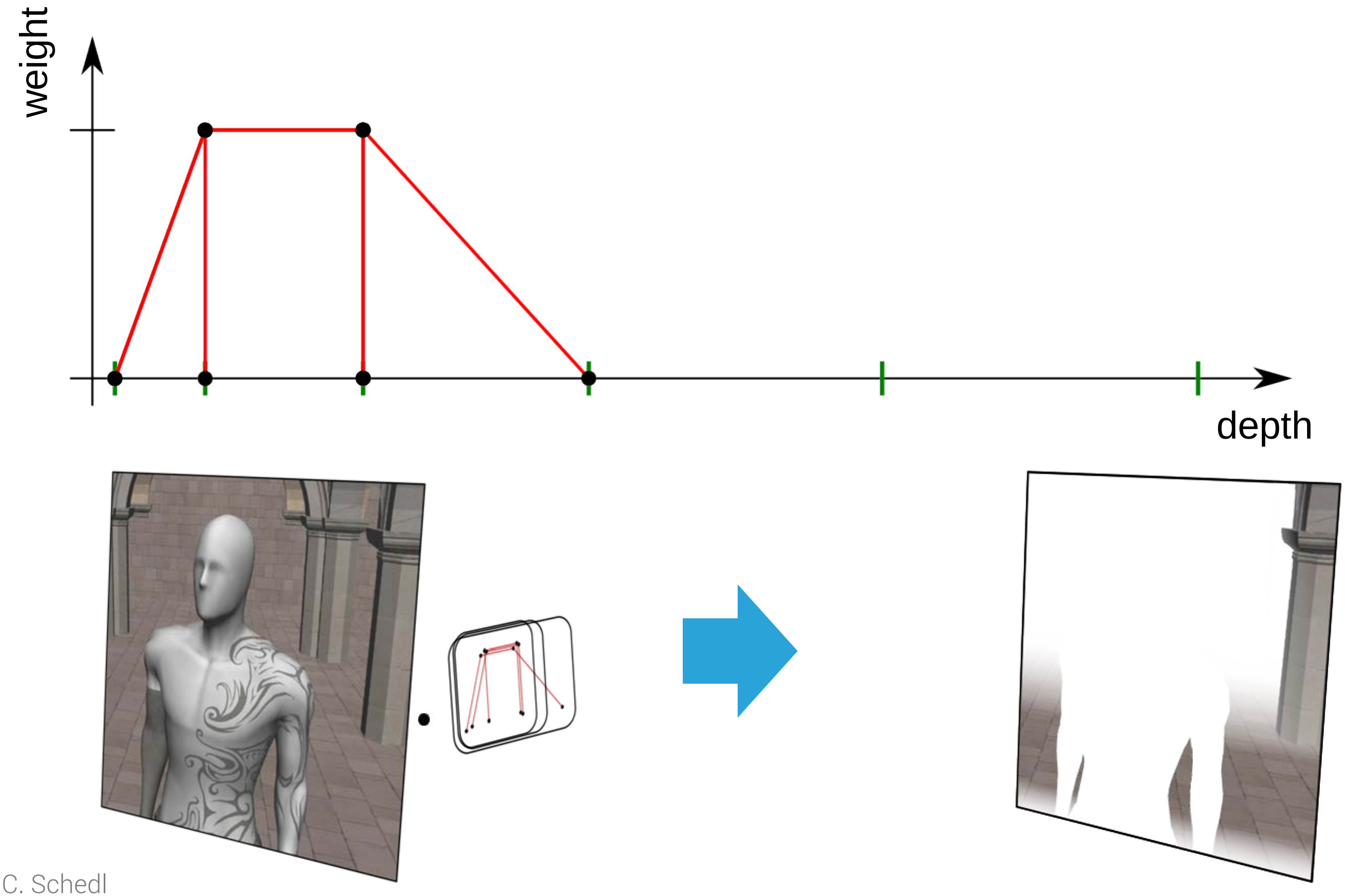
Overview



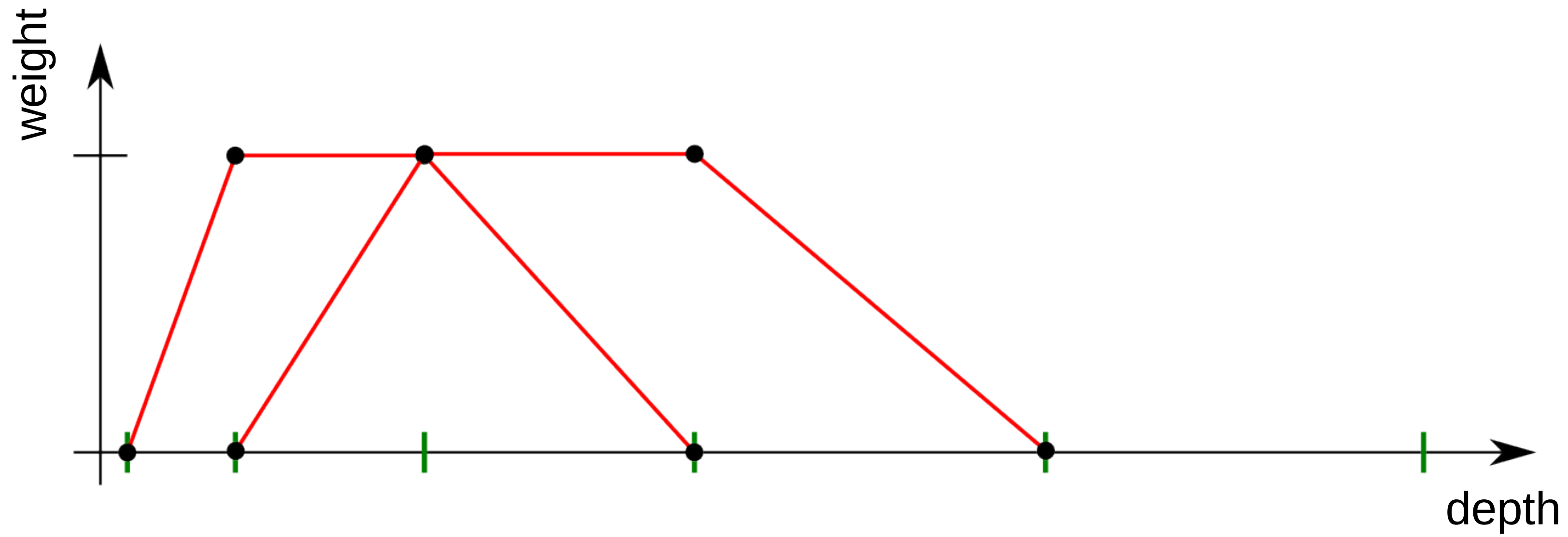
Rendering & Depth Peeling

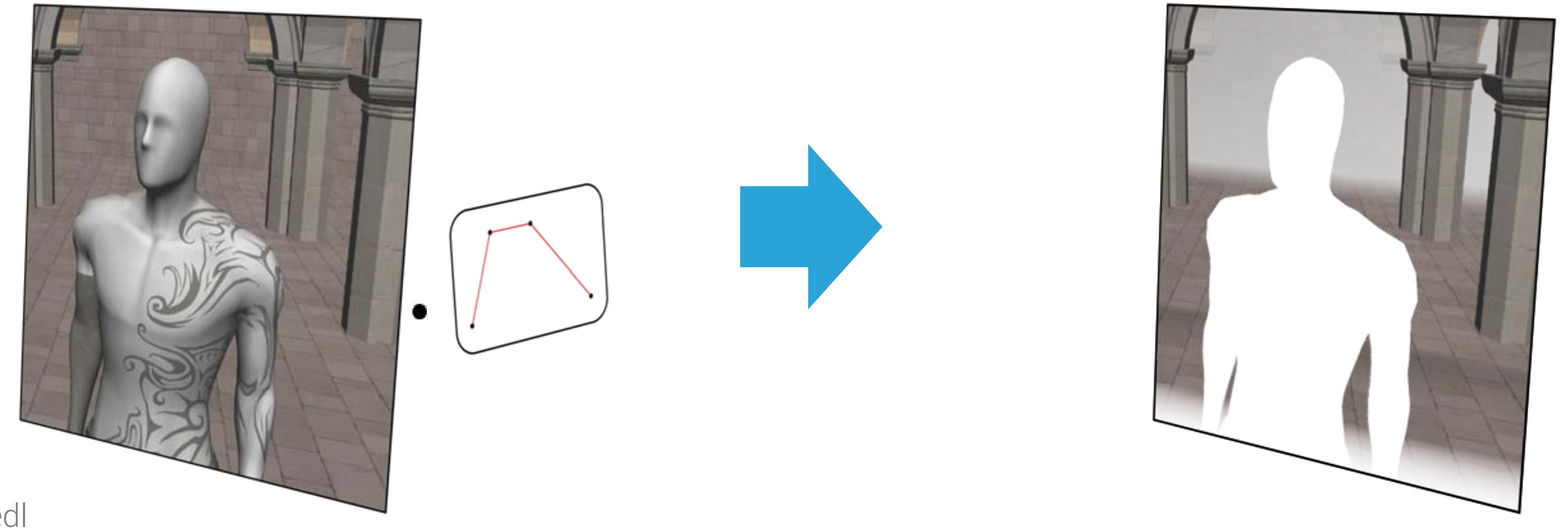


Matting – functions

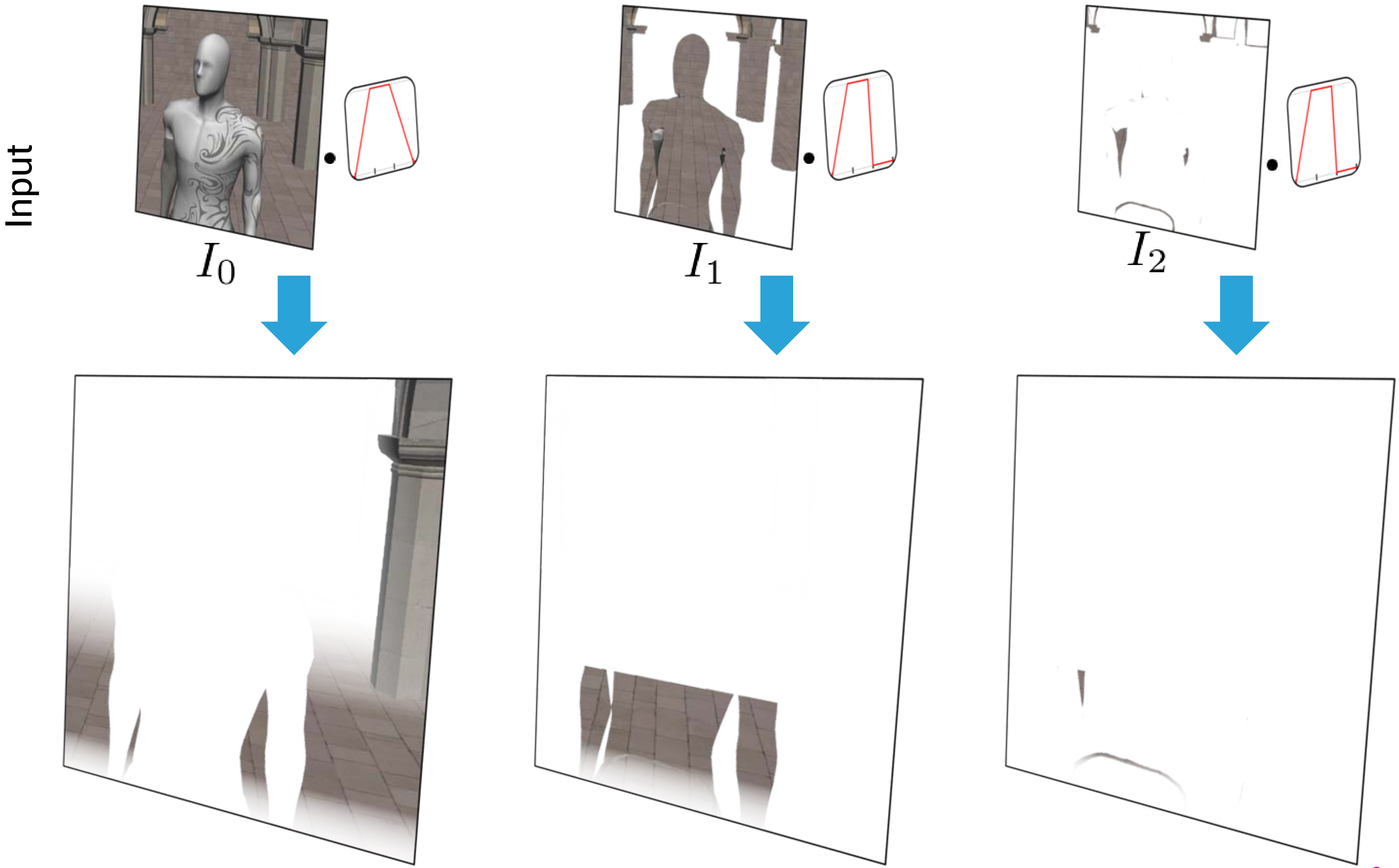


Matting – functions

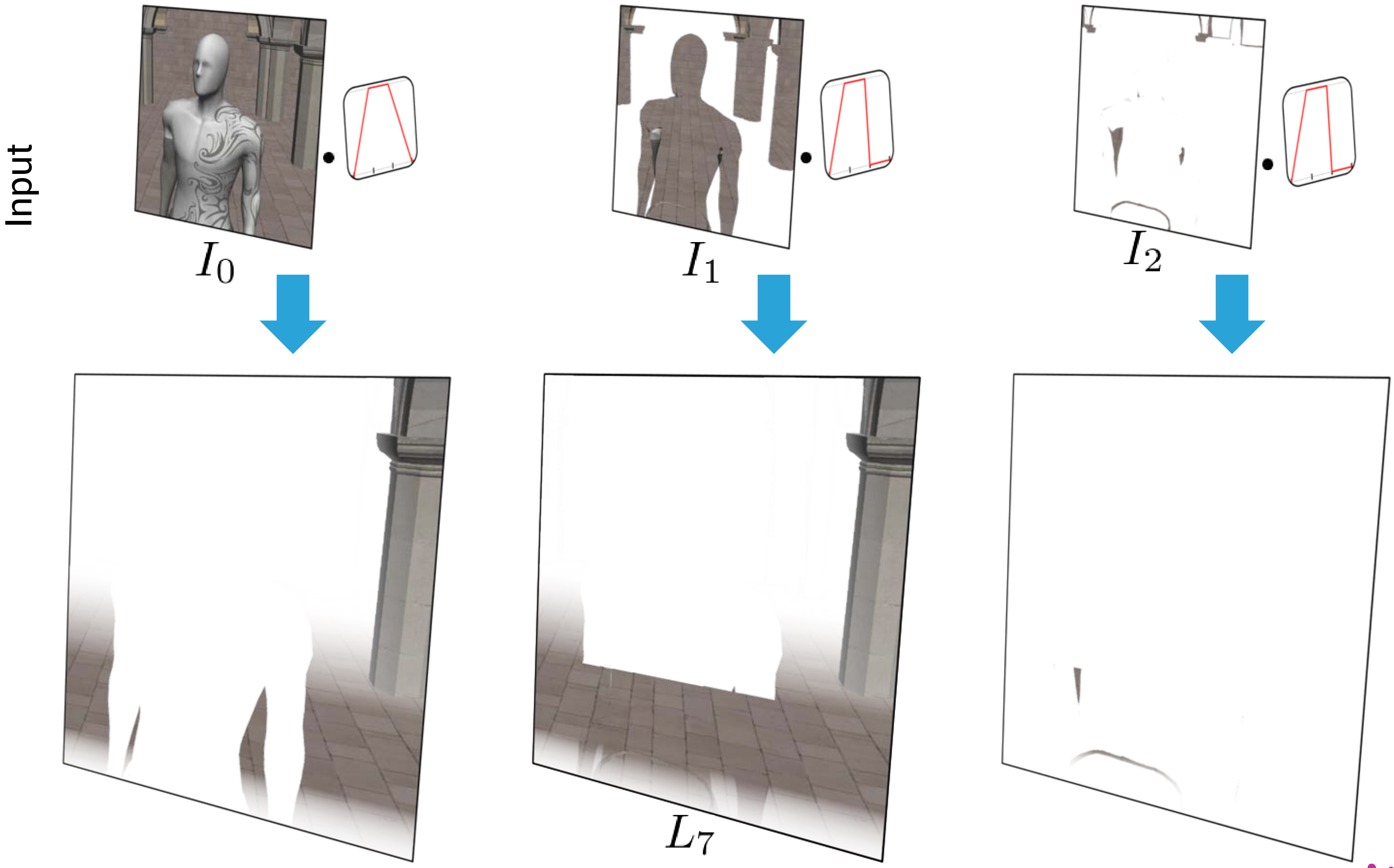




Matting – layers



Matting – layers



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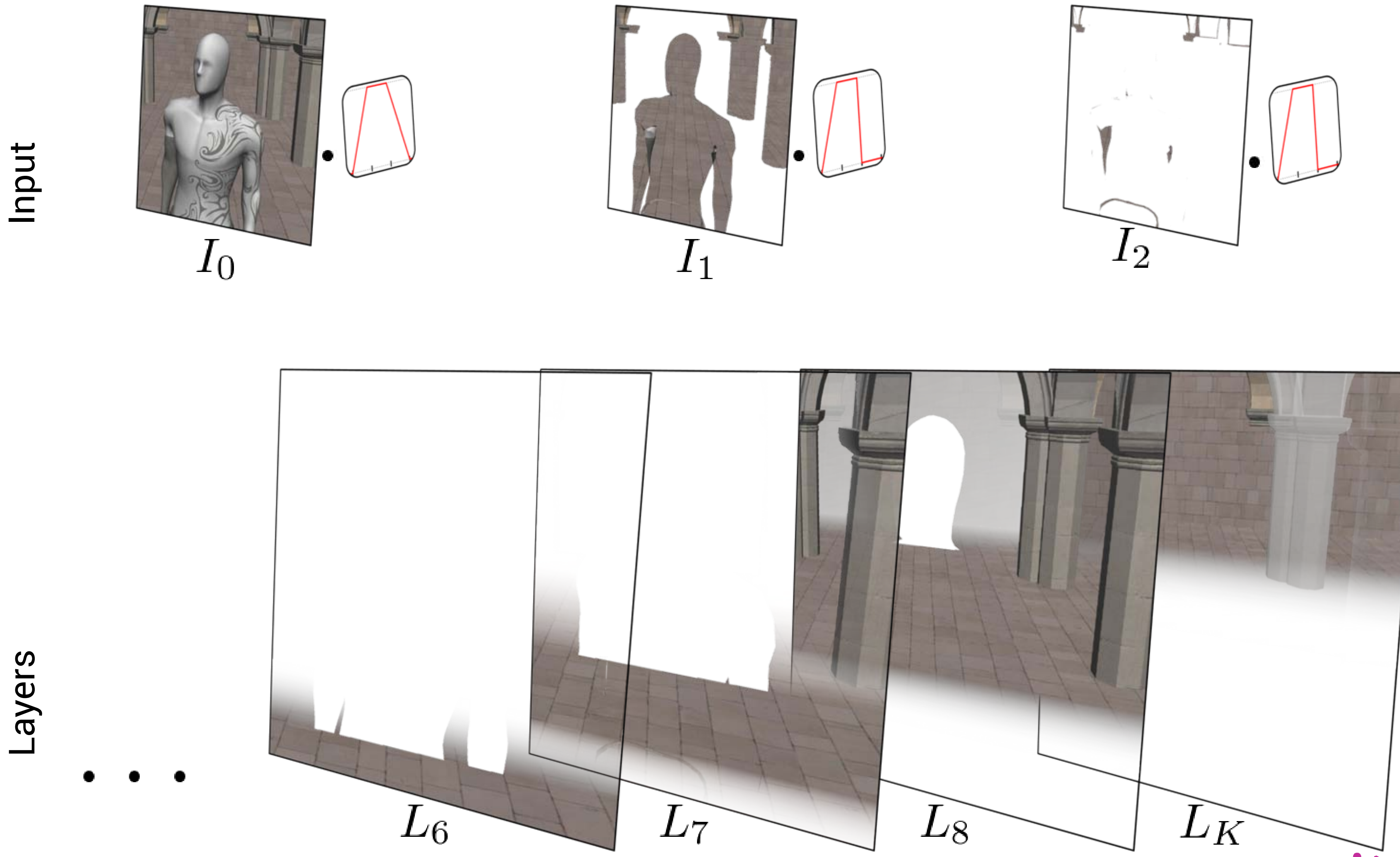

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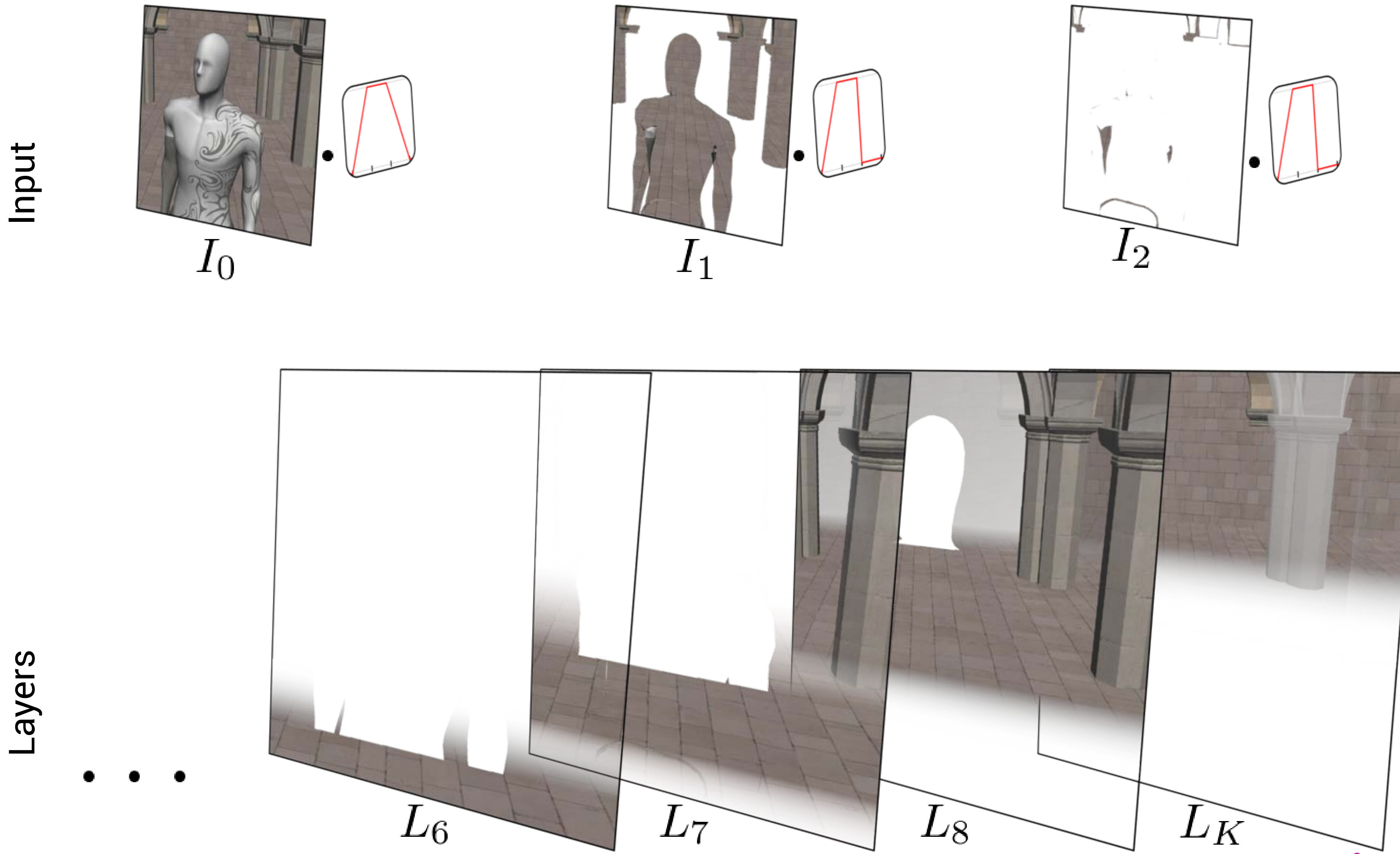

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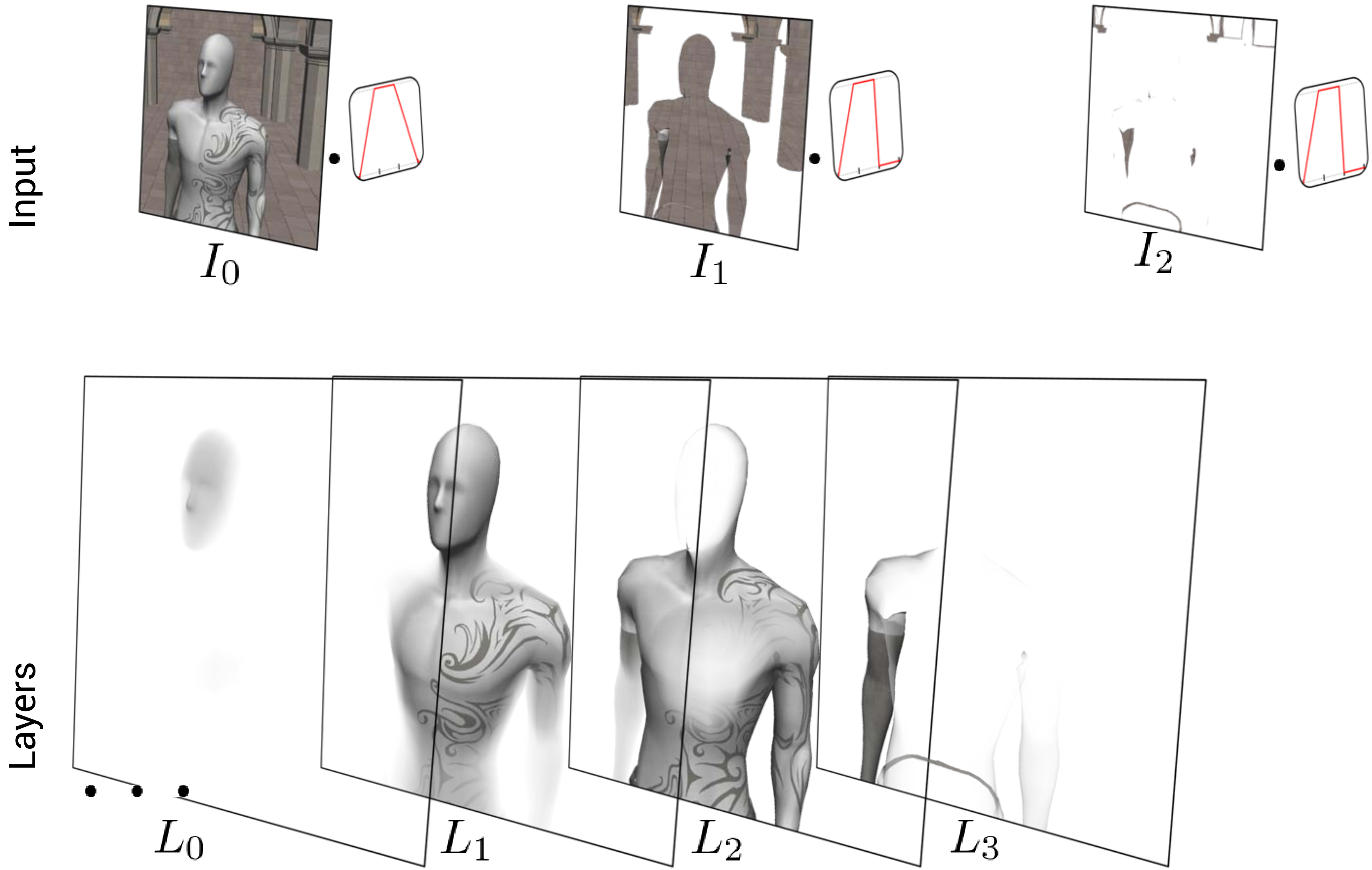
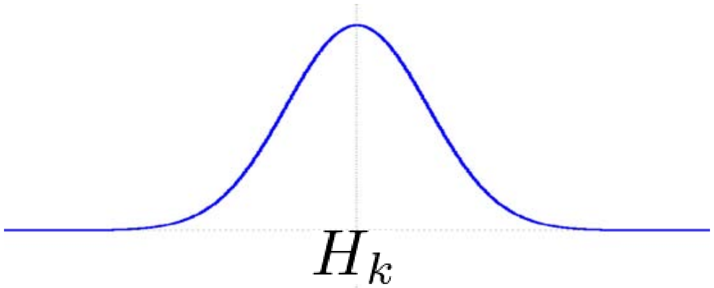
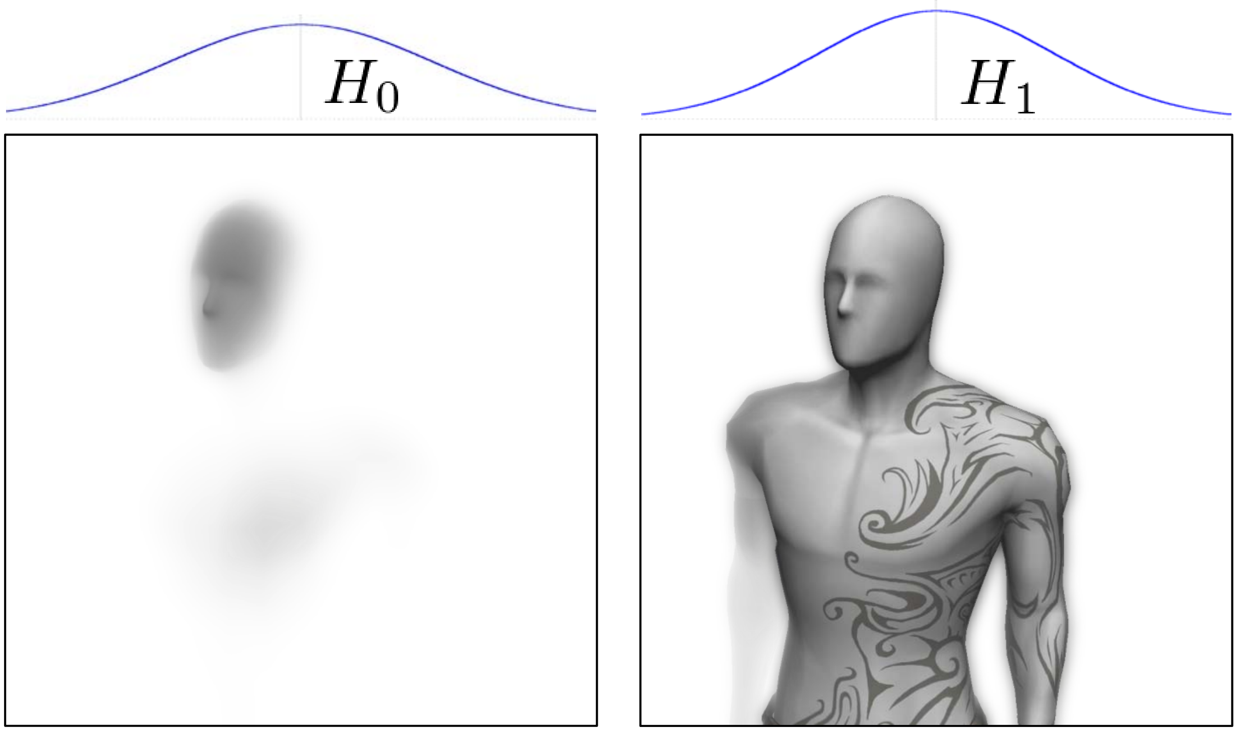


Blurring

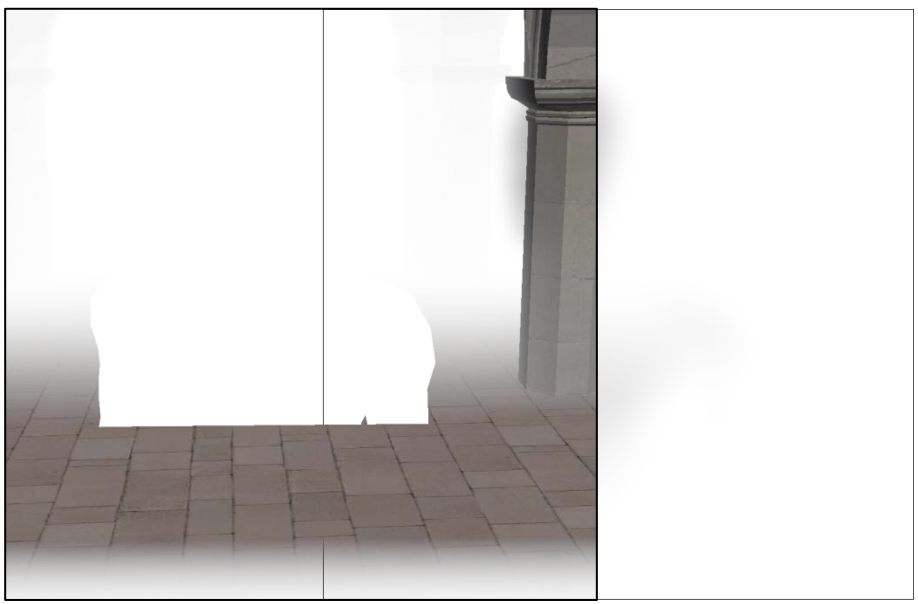
- uniformly blur layers
- Gaussian filter



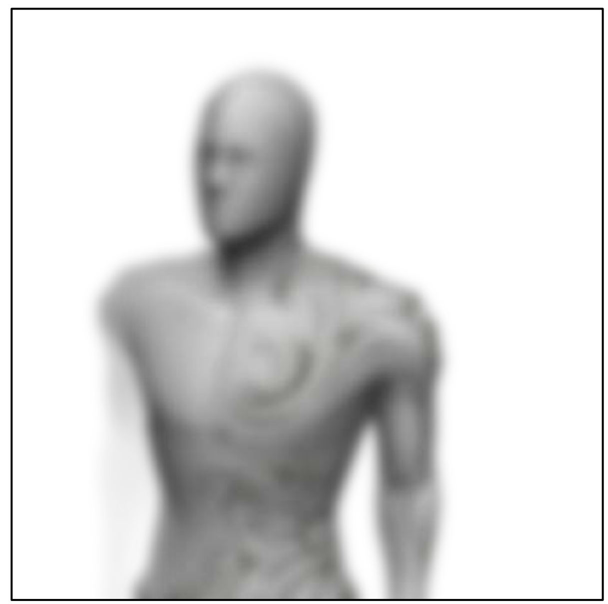


$L_0' = L_0 * H_0$ $\quad$ ${L_1}' = L_1 * H_1$

Blurring



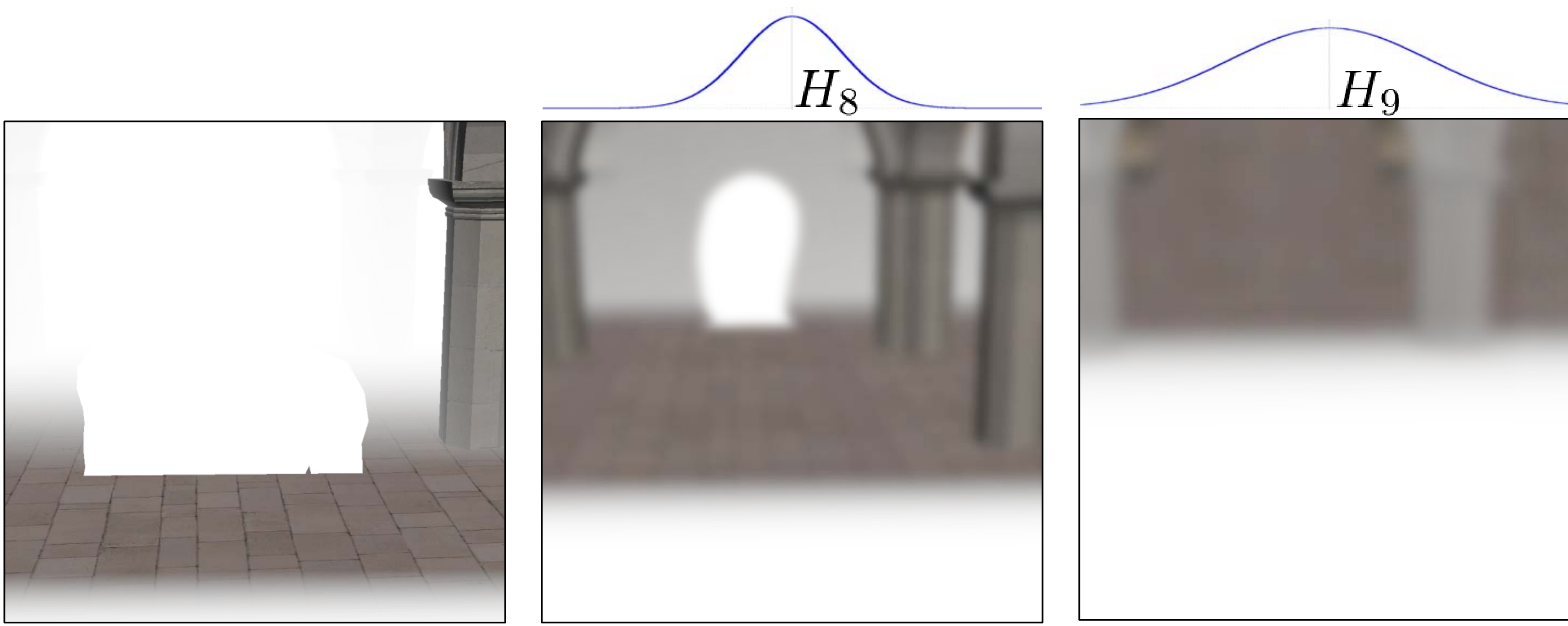
$L'_{k_{\text{focus}}} = L_{k_{\text{focus}}}$ $L'_0 = L_0 * H_0$



$L_1{}' = L_1 * H_1$

$\cdots$

Blurring



$L'_{k_{\text{focus}}} = L_{k_{\text{focus}}}$ L'_8 L'_9

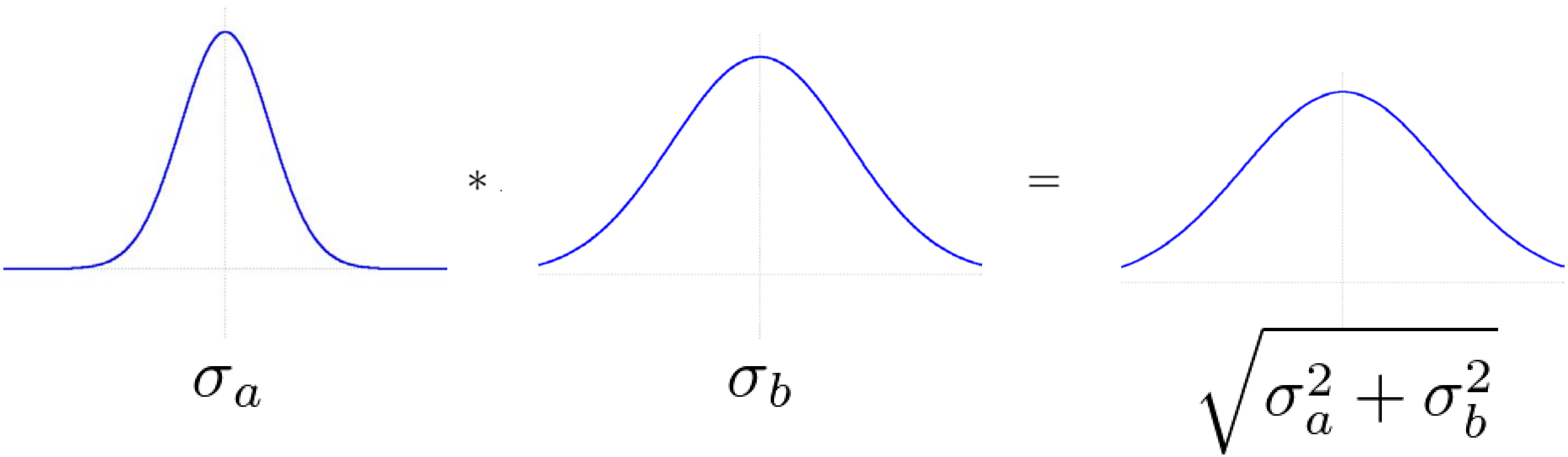
Compose

- alpha-blend back to front

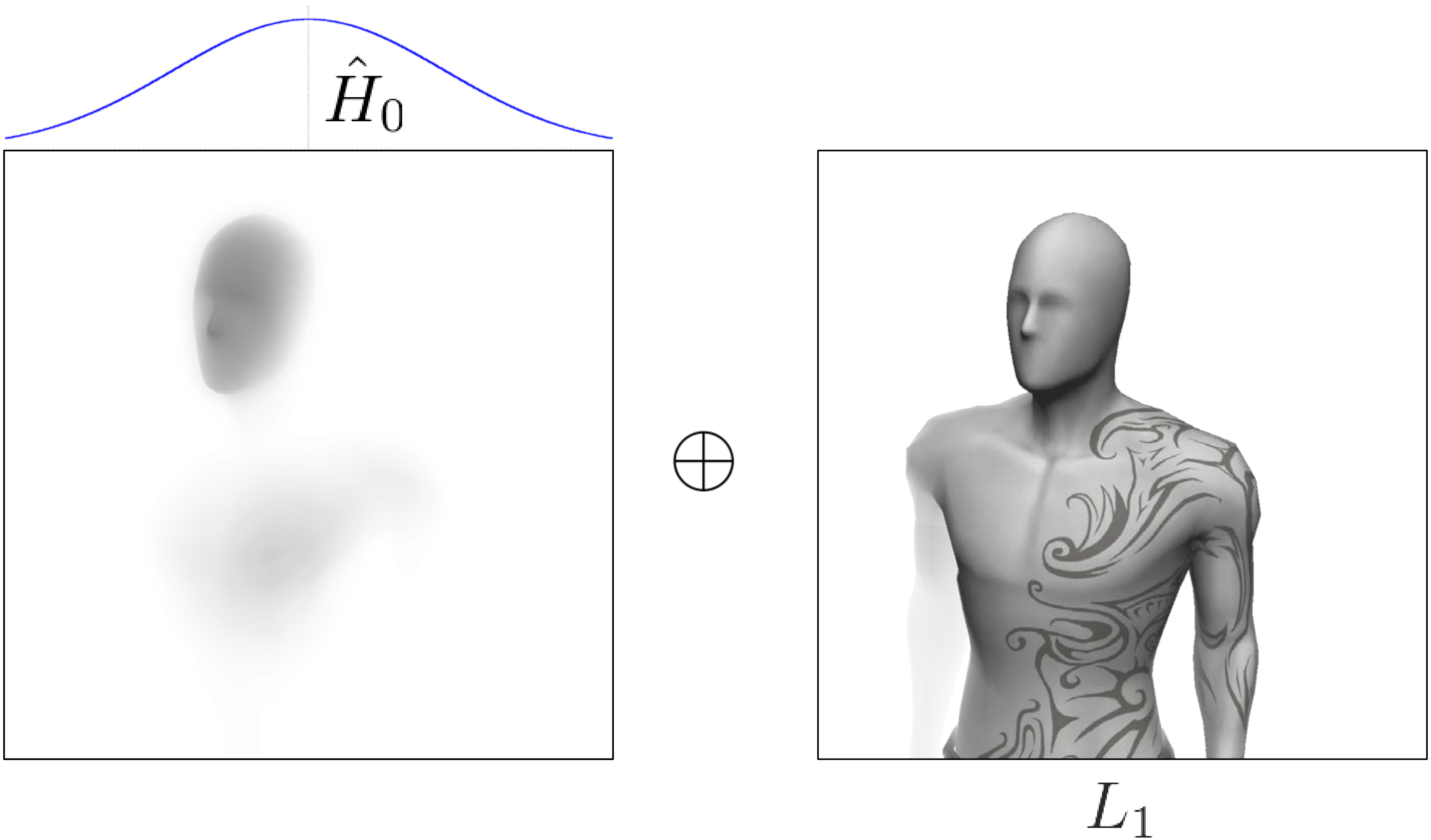
I'

Optimization

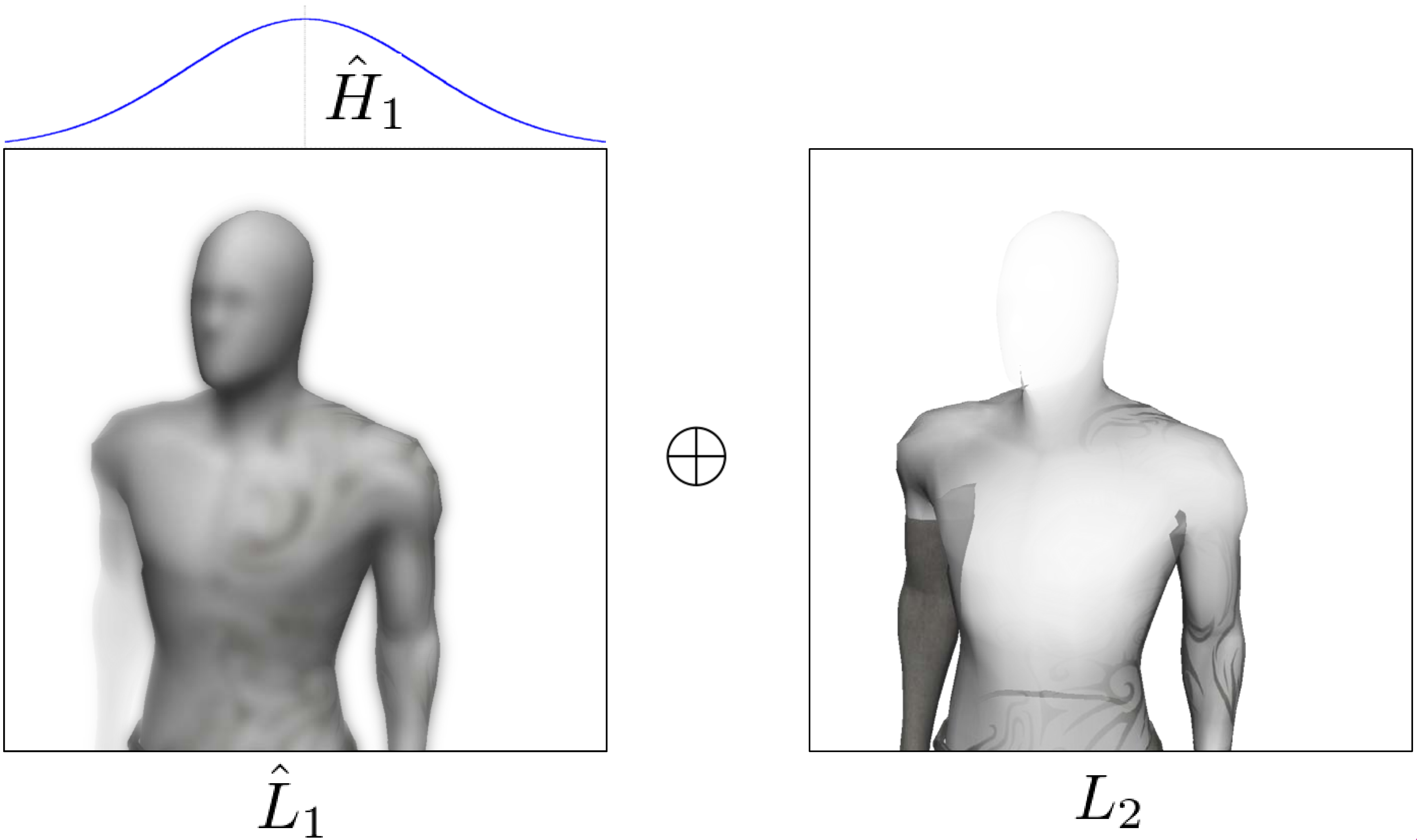
- reduce filter width
- recursive Gaussians



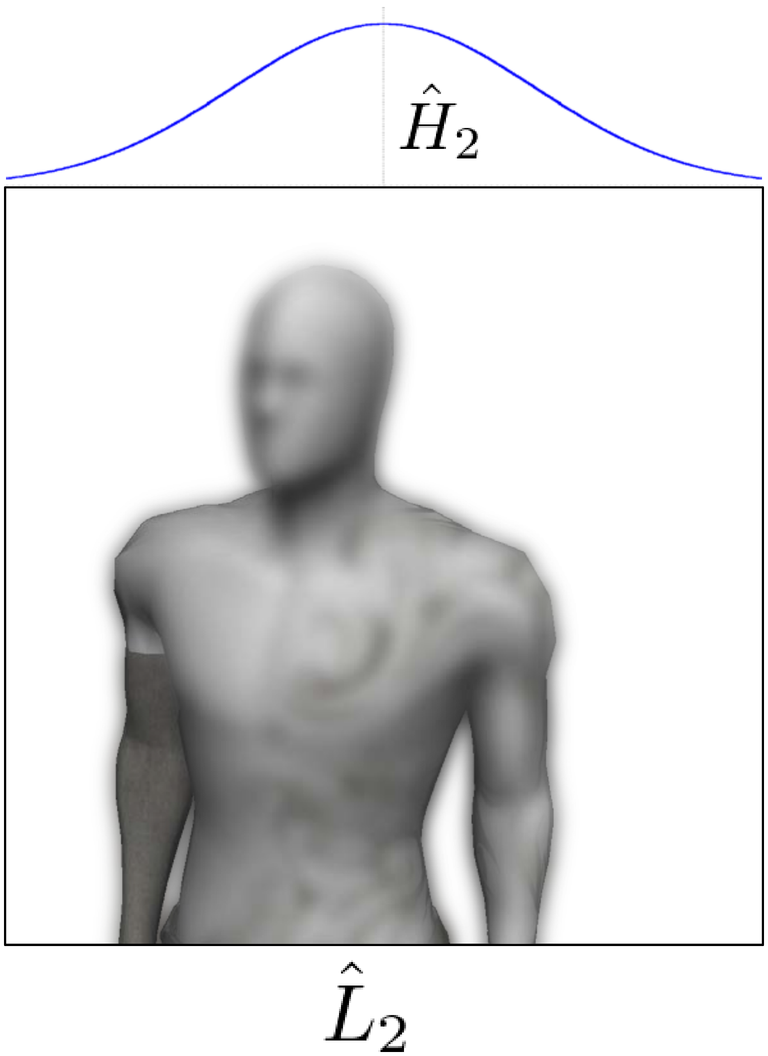
Optimization - front



Optimization - front

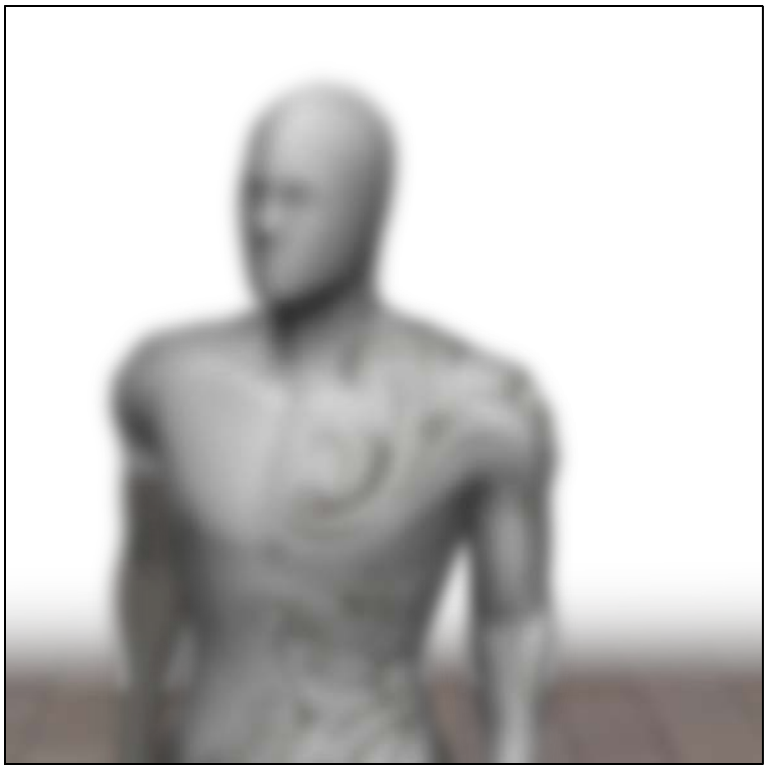


Optimization - front



$\oplus \cdots$

Optimization - Compositing

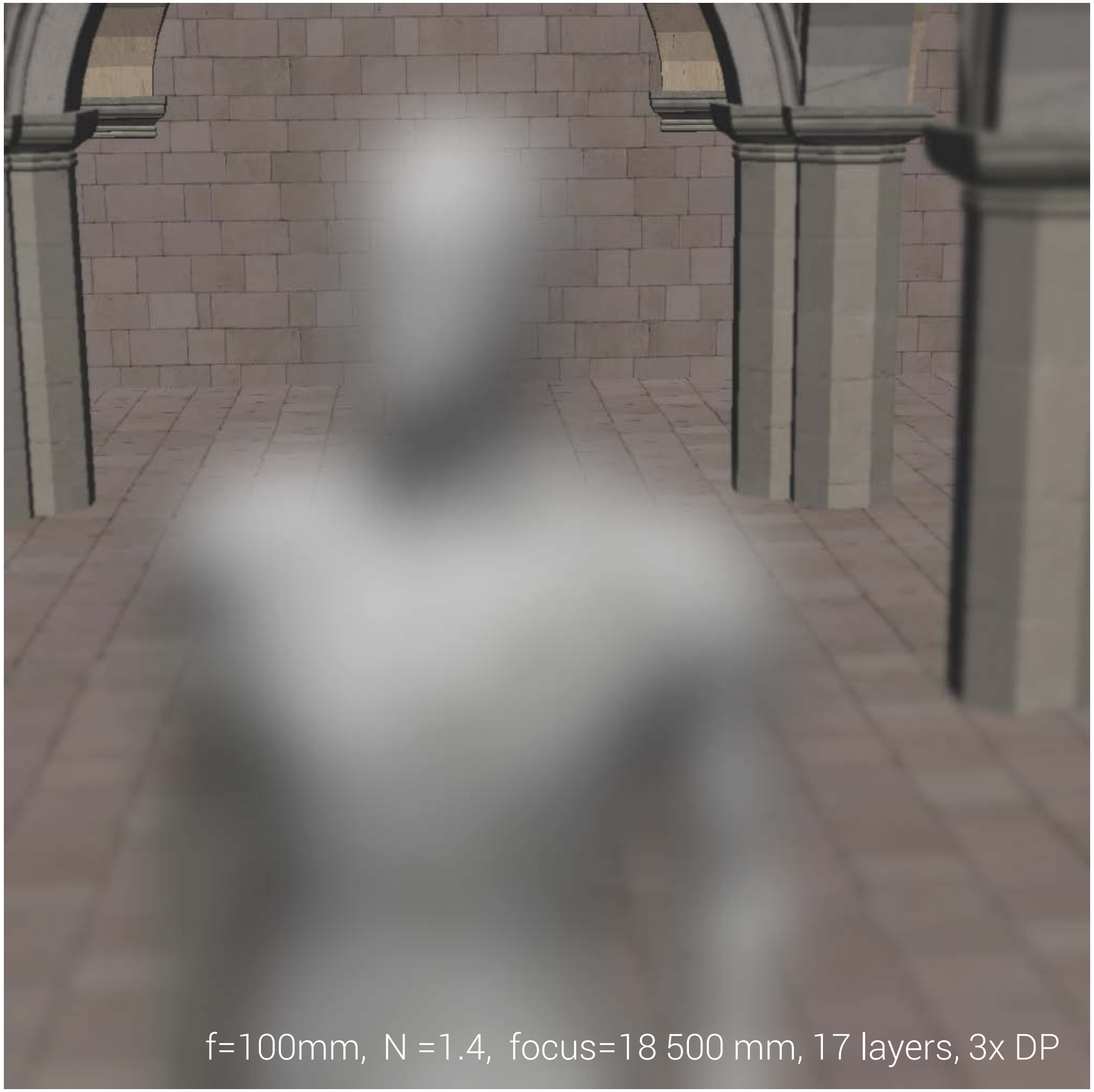


$\oplus$

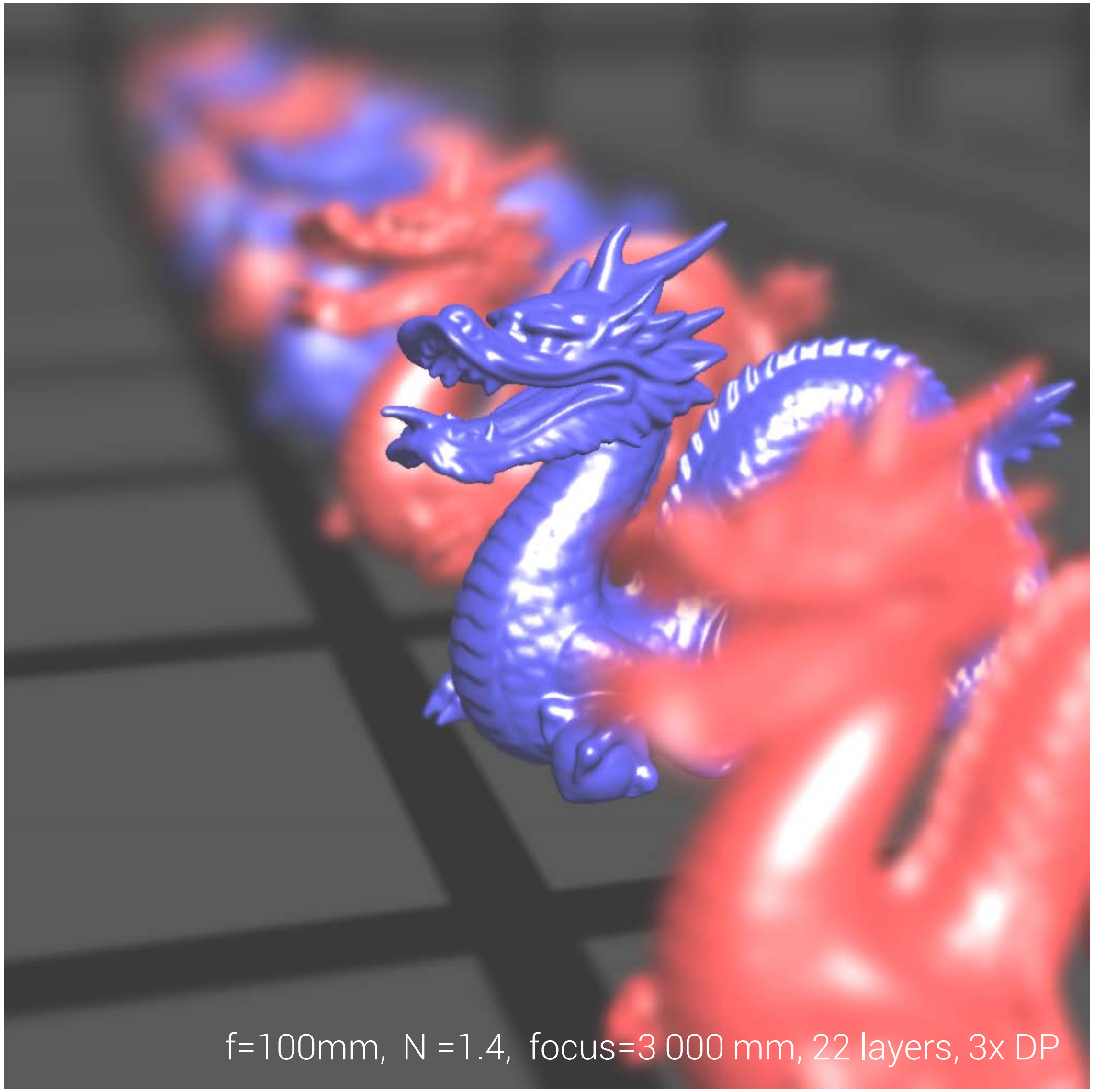
I'

$\hat{L}_{|}L_{k_{\mathrm{focus}}}$

Results - Homunculus



Results - Dragons



Results – Benchmarks

- Intel Core i7 920, Geforce GTX 480
- OpenGL and GLSL
- 1024 x 1024px

	ours		**Lee et. al. 2010**	**Accum. B.**
	optimized	non-rec.	256 rays	256 views
Homunculus (74k tri.)	102 ms	1.4x	13.2x	47x
Dragons (610k tri.)	98 ms	1.3x	14.7x	42x

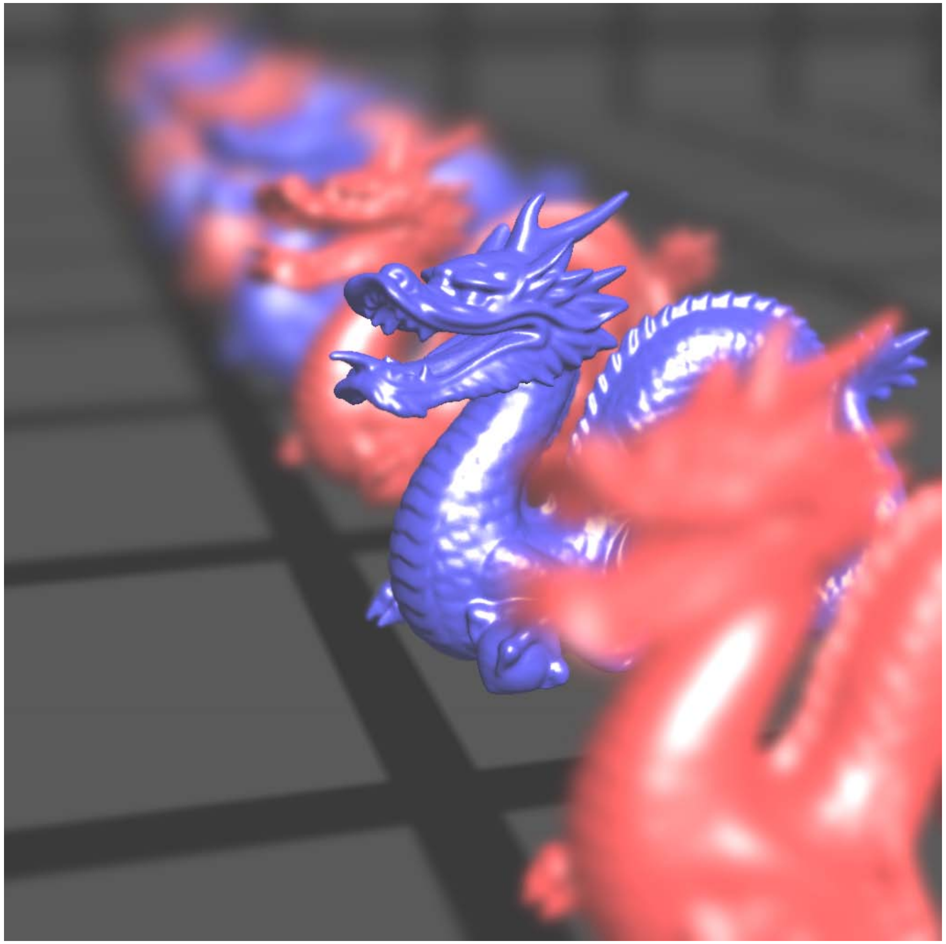
Conclusion

- layered DoF method
- partial occlusion solved
- comparison to:
  - Accumulation Buffer
  - Lee et al., 2010
- optimized by recursive Gaussians
- efficient composition with alpha blending

Outlook

- screen-spaced antialiasing
- avoid empty layers: clustering
- inaccurate but faster blurring methods
- combine with eye-tracker

Thank you!



slides will be available at:

http://www.cg.tuwien.ac.at/research/publications/2012/schedl-2012-dof/