GaSLight

Gaussian Splats for Spatially-Varying Lighting in HDR

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MOTIVATION: Accurate lighting is essential to ensure realism and aesthetics when inserting virtual content. Capturing a scene's exact illumination at every point is still facing significant limitations. Foremost, high dynamic range (HDR) imaging requires time consuming multi-exposure or specialized hardware. Another challenge is capturing both high-frequency and spatially-varying illumination.

We introduce GaSLight, a novel method that **turns a limited amount of LDR images into a consistent 3D lighting representation.**

View 1

View 2

View 3

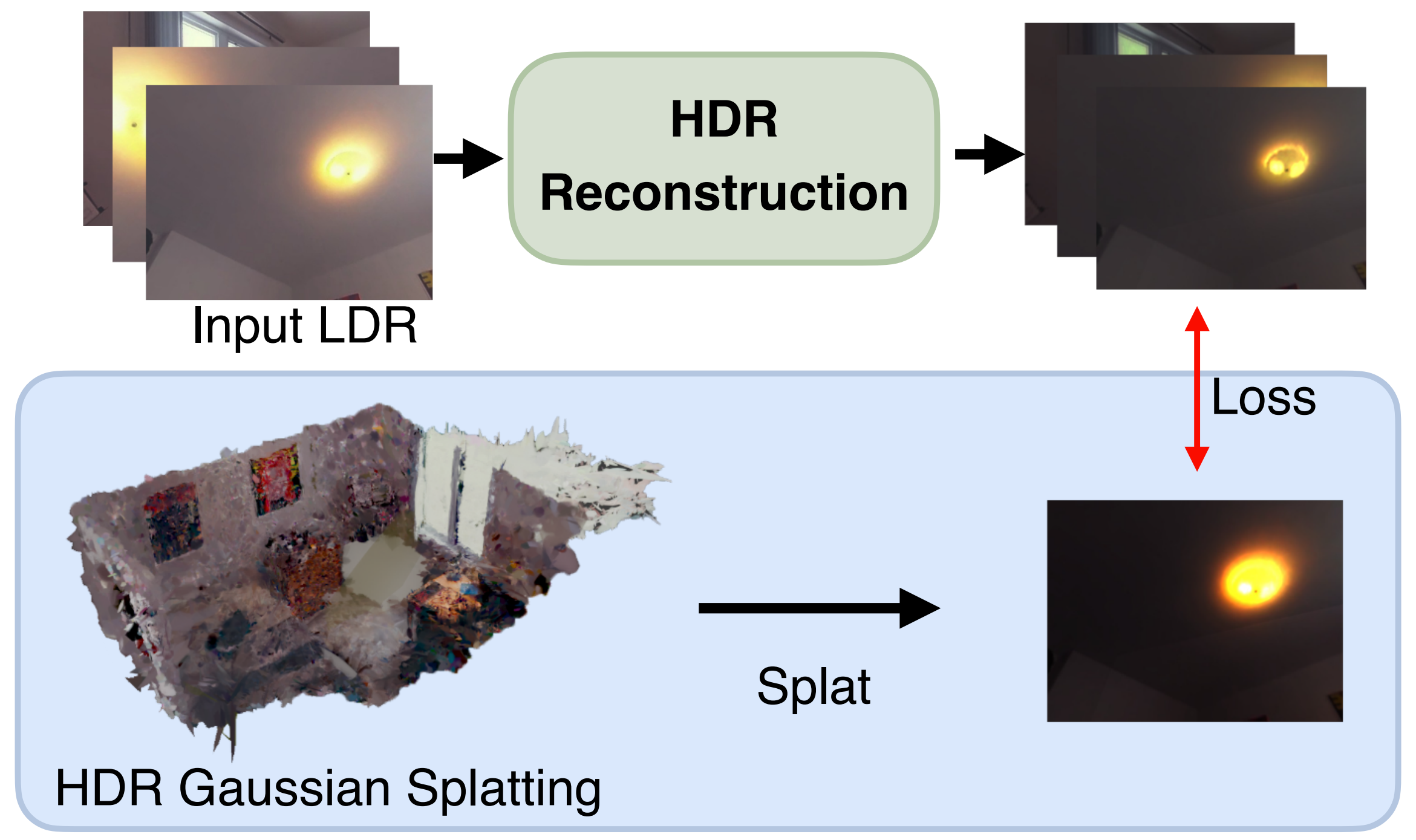
CONTRIBUTIONS

I. **Spatially-Varying HDR Representation:** We utilize Gaussian Splatting to encode lighting and demonstrate its usability in 3D rendering engines.

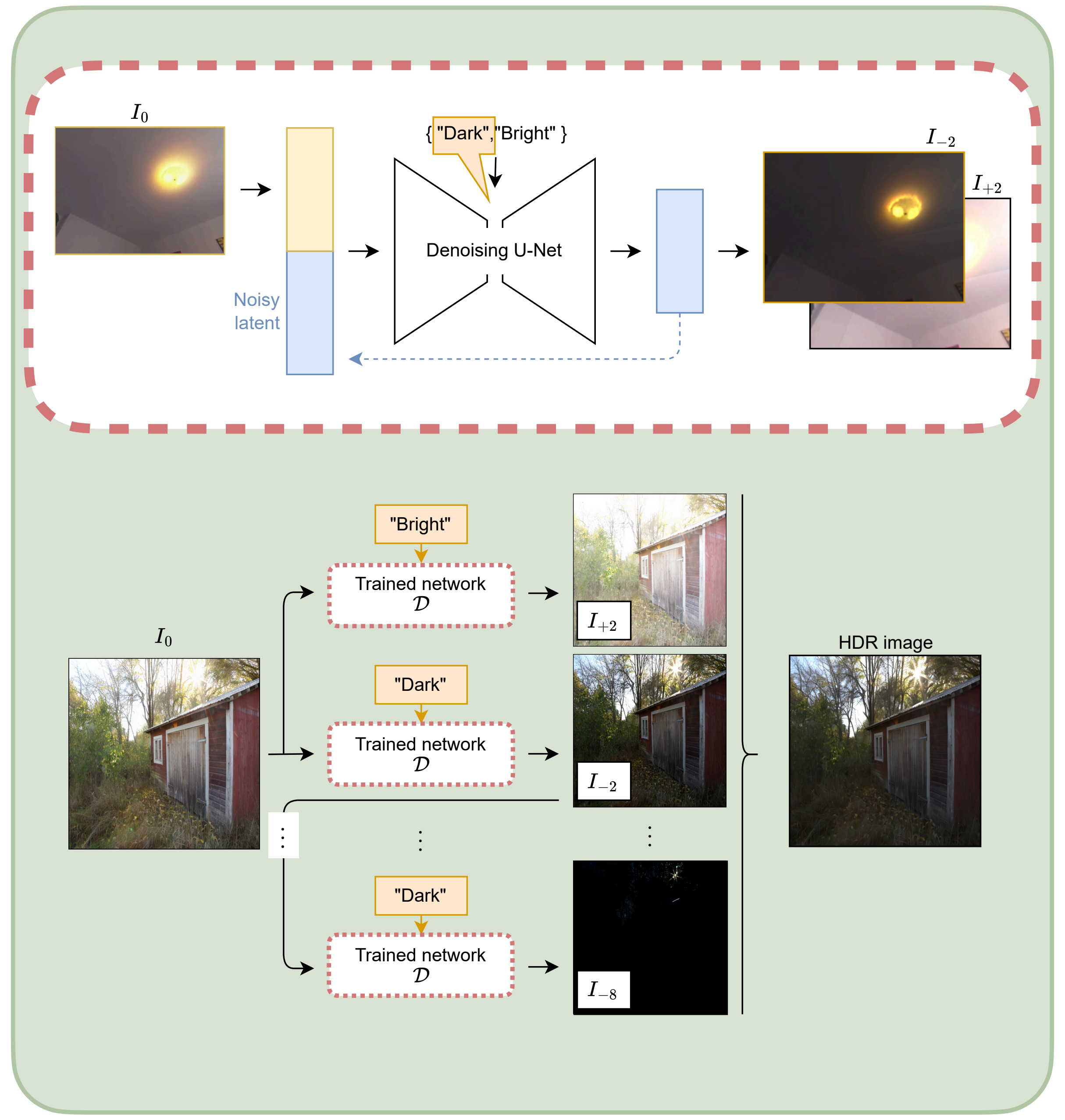
II. **HDR Reconstruction:** Using diffusion model priors, we propose a novel method to extend the dynamic range of standard images to unsaturated HDR.

III. **Image Editing Applications:** We showcase the effectiveness of our method for relighting.

GaSLight Framework

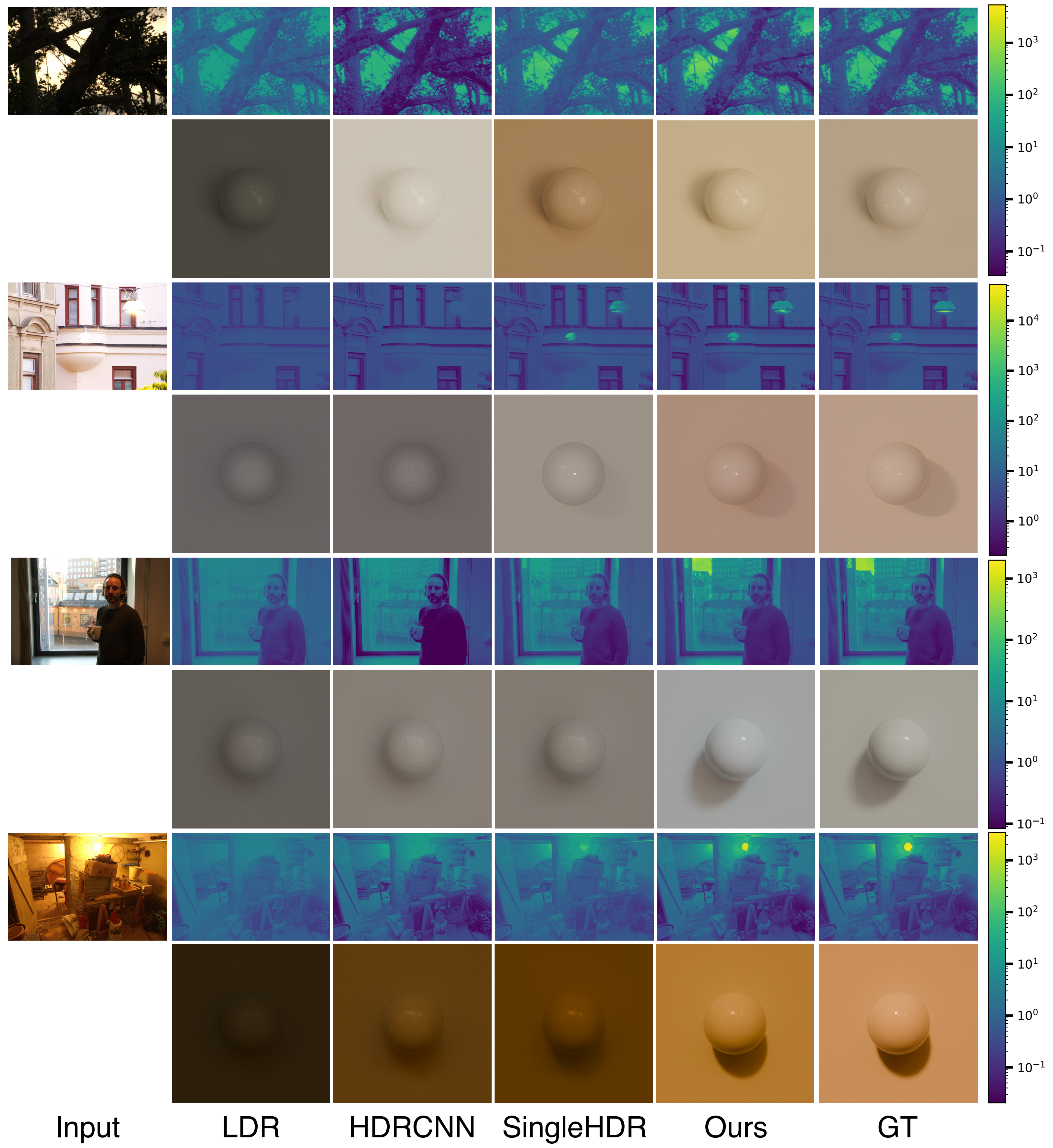

Input LDR
HDR Reconstruction
Loss
Splat
HDR Gaussian Splatting

HDR Reconstruction Pipeline


I_0
{ "Dark", "Bright" }
Noisy latent
Denoising U-Net
I_{-2}
I_{+2}
"Bright"
Trained network $\mathcal{D}$
"Dark"
Trained network $\mathcal{D}$
"Dark"
Trained network $\mathcal{D}$
I_{+2}
I_{-2}
I_{-8}
HDR image

HDR Reconstruction

HDR Reconstruction results, displayed as luminance maps and relit spheres



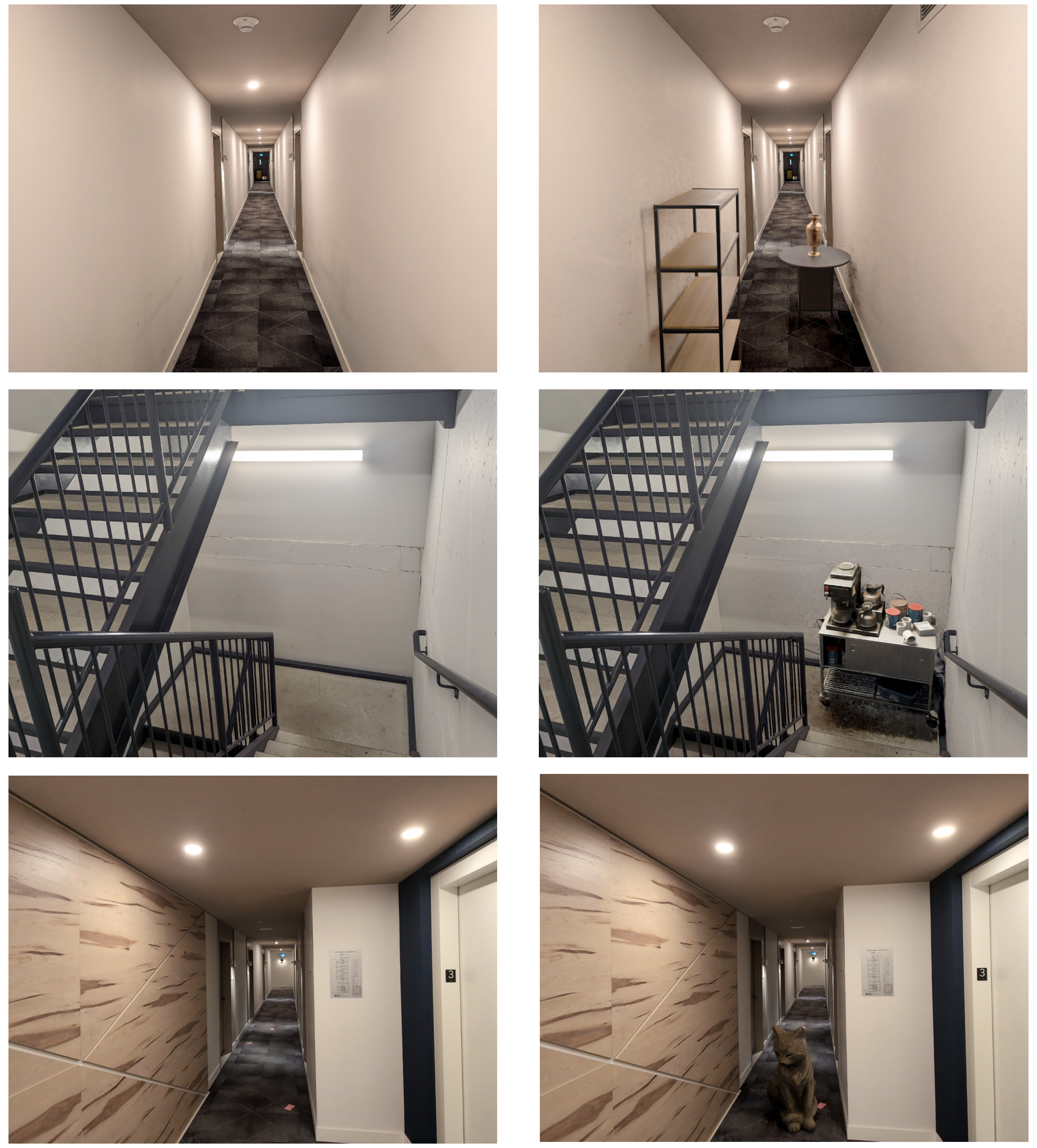
Quantitative results of HDR Reconstruction

	Relight			HDR	
Method	MSE↓	PSNR↑	Ang err↓	H-VDP3↑	P-PIQE↓
LDR	0.0715	13.0605	2.77	6.86	88.38
HDRCNN	0.0246	23.6138	2.59	8.47	59.13
MaskHDR	0.0243	23.5503	2.52	8.54	58.33
SingleHDR	0.0178	24.0680	3.32	8.57	40.34
ExpandNet	0.0187	24.7158	2.10	8.48	58.11
Exposure Diff.	0.0264	23.7384	8.23	7.88	47.94
Ours	0.0131	25.3895	2.17	8.49	40.17

Best Second Third

Re-lighting results

GaSLight used for virtual objects insertion


Input image Inserted objects

Text to lighting (with LucidDreamer)

Pairing GaSLight with LucidDreamer for text-to-lighting

Prompt: *A gas lamp standing on a table in the center of a dark living room*

Prompt: *A library with a window on one side*