

PanDORA: Casual HDR Radiance Acquisition for Indoor Scenes

Supplementary document

Supplementary Material

1. Quantitative results per scene

Tab. 2 and Tab. 3 show all quantitative results for each scene in our evaluation dataset individually. The same metrics as in tab. 1 from the main paper are used.

2. More details on HDR-Nerfacto

2.1. Implementation details

Our implementation of HDR-Nerfacto matches as closely as possible the original HDR-NeRF method [1] while taking advantage of the strengths of the Nerfacto framework. Following the original HDR-NeRF implementation, we keep the HDR radiance field MLP output in the log domain and add it to the log-exposure before feeding it to the RGB CRF MLPs. We swap the HDR radiance field to the Nerfacto backbone. We remove the ReLU activation function from the output layer of this backbone, as it would prevent the model from outputting necessary negative log-exposures. The three CRF MLPs from HDR-NeRF are implemented the same way as in the original implementation, using two-layer MLPs with a width of 128. We note the importance of disabling Nerfacto’s appearance embedding, which essentially makes the network invariant to different exposures. As in HDR-NeRF, we include the unit exposure loss during training.

2.2. Obtaining HDR radiance

The radiance output of HDR-NeRF (and our implementation HDR-Nerfacto) is supposed to provide us with a linear HDR radiance output suitable for reconstructing high-quality images at any exposure. However, we find two significant problems with this output. First, the radiance output is known only up to scale; an unknown per-channel scaling factor must be obtained for each scene as a post-processing step. Even though HDR-NeRF is trained with the unit exposure loss, which regularizes the range of radiances, the scaling factors vary widely between scenes, as shown in tab. 1. Second, even after applying this scaling, the images at all the exposures exhibit extreme artifacts and are far from the ground truth, as shown in the “Radiance output” rows of fig. 1. We attribute this issue to the fact that the radiance output is underconstrained when trained with only two non-overlapping exposures, which is always the case in our setup. Instead, we choose to combine the outputs of the tonemapper module at the well- and fast-exposed exposure, which drastically improves the reconstruction quality and provides a fairer baseline, as can be seen in the “Combined” rows of fig. 1.

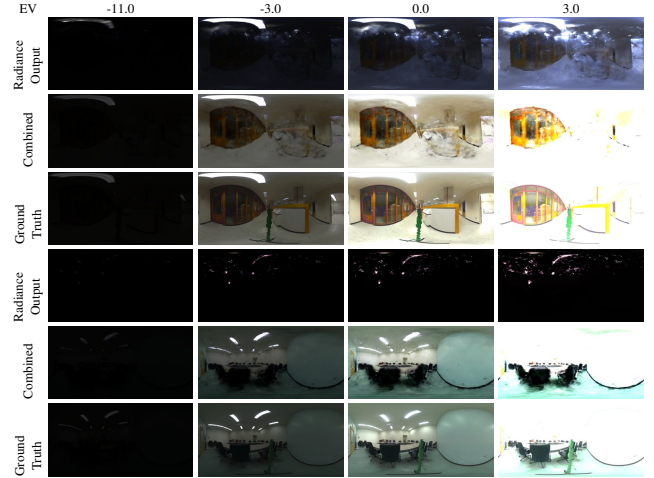


Figure 1. Comparison of the ways to evaluate a trained HDR-Nerfacto model. The radiance output of HDR-Nerfacto needs to be scaled by an unknown color balance term (which was obtained from the ground truth here) and suffers from poor image quality, generating various artifacts. Instead, we combine the outputs of the tonemapper module at the well- and fast-exposed exposure to provide a fairer baseline.

Scene	Radiance scale factor		
	Red	Green	Blue
BASEMENT	3.22×10^{-3}	3.71×10^{-3}	9.18×10^{-3}
MEETING ROOM	3.14×10^{-6}	5.57×10^{-7}	1.73×10^{-6}

Table 1. HDR-Nerfacto’s radiance output has different scale factors per scene and color channel, which require additional computation to obtain. Here, we divide the per-channel mean value of the GT radiance with HDR-Nerfacto’s to infer the scale factor.

Table 2. Quantitative results on the first seven scenes of our dataset of 14 real scenes. Metrics are shown in 4 groups (left to right): LDR panoramas, HDR panoramas, HDR and LDR renders (“LDR r.”). For “renders”, we use the HDR panoramas to render a virtual scene (see fig. 7 from the paper), the metrics are computed on the result.

Scene	Method	LDR panos			HDR panos			HDR render			LDR r.
		PSNR \uparrow	SSIM \uparrow	LPIPS \downarrow	PU-PSNR \uparrow	HDR-VDP \uparrow	PU-SSIM \uparrow	si-RMSE \downarrow	RMSE \downarrow	RGB ang. \downarrow	PSNR \uparrow
LOBBY	LDR-Nerfacto	20.09	0.629	0.338	24.57	6.520	0.885	0.457	0.605	3.76	27.37
	PanoHDR-Nerfacto	19.36	0.577	0.414	27.44	6.793	0.878	0.390	0.494	9.95	28.11
	HDR-Nerfacto	19.41	0.537	0.481	24.35	6.076	0.874	0.462	0.600	3.46	27.37
	PanDORA (ours)	19.32	0.576	0.393	25.59	6.177	0.877	0.467	0.551	4.26	28.04
CLUBHOUSE	LDR-Nerfacto	17.53	0.588	0.421	23.82	5.745	0.848	0.616	1.315	10.70	27.97
	PanoHDR-Nerfacto	16.71	0.509	0.465	25.22	6.373	0.827	0.580	1.025	10.92	28.12
	HDR-Nerfacto	17.03	0.536	0.521	24.90	6.110	0.831	0.322	1.114	5.46	27.86
	PanDORA (ours)	17.26	0.559	0.442	24.44	5.731	0.844	0.420	0.951	7.28	28.98
LIVING ROOM	LDR-Nerfacto	16.93	0.596	0.424	30.68	6.609	0.767	0.141	0.156	7.13	30.12
	PanoHDR-Nerfacto	17.57	0.576	0.476	28.57	6.515	0.796	0.143	0.366	8.72	29.09
	HDR-Nerfacto	17.17	0.571	0.506	31.39	6.446	0.781	0.117	0.158	8.11	29.28
	PanDORA (ours)	16.59	0.580	0.431	30.48	6.438	0.762	0.107	0.219	7.57	29.00
BLUE BEDROOM	LDR-Nerfacto	21.46	0.748	0.396	28.44	6.762	0.922	0.476	0.525	3.05	27.43
	PanoHDR-Nerfacto	19.32	0.663	0.461	28.31	7.372	0.873	0.0418	0.134	5.46	27.52
	HDR-Nerfacto	20.09	0.685	0.494	27.44	6.604	0.904	0.494	0.529	4.90	28.00
	PanDORA (ours)	21.49	0.729	0.398	28.48	7.358	0.921	0.475	0.52	3.66	27.99
MEETING ROOM	LDR-Nerfacto	22.17	0.734	0.404	25.93	6.462	0.940	0.183	0.356	1.48	28.20
	PanoHDR-Nerfacto	21.76	0.708	0.433	29.77	6.810	0.940	0.129	0.158	5.00	29.75
	HDR-Nerfacto	21.12	0.684	0.480	28.11	6.541	0.932	0.146	0.274	1.61	28.59
	PanDORA (ours)	21.96	0.728	0.402	29.56	6.947	0.941	0.109	0.126	2.19	32.17
AUDITORIUM	LDR-Nerfacto	18.41	0.619	0.384	26.67	5.979	0.899	0.093	0.159	5.49	27.59
	PanoHDR-Nerfacto	18.22	0.570	0.404	25.77	6.019	0.890	0.076	0.108	7.05	29.31
	HDR-Nerfacto	17.92	0.588	0.445	26.47	5.984	0.884	0.069	0.167	2.85	27.57
	PanDORA (ours)	18.34	0.614	0.372	26.58	6.437	0.896	0.042	0.053	4.60	30.19
CLASS NO. WIN.	LDR-Nerfacto	20.03	0.739	0.362	26.20	5.820	0.920	0.151	0.288	1.98	27.59
	PanoHDR-Nerfacto	20.32	0.717	0.374	27.77	6.619	0.931	0.057	0.186	1.19	28.23
	HDR-Nerfacto	19.65	0.699	0.445	26.24	6.267	0.920	0.151	0.265	1.83	27.69
	PanDORA (ours)	19.80	0.733	0.367	29.99	6.698	0.923	0.084	0.123	1.68	28.07

Table 3. Quantitative results on the second seven scenes of our dataset of 14 real scenes. Metrics are shown in 4 groups (left to right): LDR panoramas, HDR panoramas, HDR and LDR renders (“LDR r.”). For “renders”, we use the HDR panoramas to render a virtual scene (see fig. 7 from the paper), the metrics are computed on the result.

Scene	Method	LDR panos			HDR panos			HDR render			LDR r.
		PSNR \uparrow	SSIM \uparrow	LPIPS \downarrow	PU-PSNR \uparrow	HDR-VDP \uparrow	PU-SSIM \uparrow	si-RMSE \downarrow	RMSE \downarrow	RGB ang. \downarrow	PSNR \uparrow
CLASS W. WIN.	LDR-Nerfacto	19.695	0.670	0.375	25.51	5.603	0.907	0.163	0.377	2.76	27.84
	PanoHDR-Nerfacto	19.45	0.654	0.406	28.88	6.798	0.912	0.113	0.159	2.85	30.27
	HDR-Nerfacto	19.11	0.622	0.482	25.34	6.093	0.898	0.168	0.368	3.01	27.81
	PanDORA (ours)	19.58	0.662	0.382	28.84	6.723	0.912	0.112	0.149	2.54	29.31
BASEMENT	LDR-Nerfacto	19.49	0.637	0.411	26.61	6.063	0.916	0.454	0.205	6.18	27.89
	PanoHDR-Nerfacto	18.85	0.582	0.462	26.24	6.326	0.904	0.159	0.547	7.05	28.68
	HDR-Nerfacto	19.12	0.608	0.442	29.22	6.497	0.913	0.063	0.118	2.46	29.92
	PanDORA (ours)	19.18	0.612	0.434	29.22	6.532	0.912	0.061	0.121	2.42	29.96
SMALL OFFICE	LDR-Nerfacto	20.61	0.670	0.389	26.15	6.191	0.928	0.189	0.346	8.14	28.09
	PanoHDR-Nerfacto	19.23	0.623	0.480	31.55	6.691	0.926	0.093	0.194	6.79	29.09
	HDR-Nerfacto	19.23	0.480	0.623	28.78	6.283	0.905	0.118	0.268	6.44	27.66
	PanDORA (ours)	20.74	0.679	0.396	32.52	6.722	0.934	0.043	0.085	1.71	28.91
COFFEE ROOM	LDR-Nerfacto	21.69	0.706	0.441	28.15	6.350	0.938	0.234	0.333	4.66	28.48
	PanoHDR-Nerfacto	21.21	0.649	0.478	31.10	6.617	0.927	0.151	0.214	2.95	30.39
	HDR-Nerfacto	19.97	0.645	0.523	28.83	6.233	0.914	0.523	0.314	4.27	28.34
	PanDORA (ours)	21.60	0.696	0.436	32.43	6.916	0.939	0.126	0.188	3.66	30.07
OFFICE	LDR-Nerfacto	21.60	0.684	0.397	28.02	6.740	0.927	0.367	0.400	3.81	27.71
	PanoHDR-Nerfacto	20.88	0.643	0.432	29.25	7.047	0.921	0.314	0.410	2.51	32.46
	HDR-Nerfacto	20.82	0.640	0.481	28.89	6.867	0.916	0.316	0.364	4.52	28.50
	PanDORA (ours)	21.44	0.677	0.392	31.38	7.319	0.926	0.204	0.236	4.51	31.06
AUDITORIUM-DARK	LDR-Nerfacto	19.77	0.621	0.361	28.99	6.334	0.921	0.132	0.197	11.44	27.57
	PanoHDR-Nerfacto	19.47	0.545	0.396	29.28	6.361	0.913	0.084	0.145	11.32	28.10
	HDR-Nerfacto	19.50	0.590	0.435	30.06	6.524	0.911	0.050	0.095	4.12	29.46
	PanDORA (ours)	19.66	0.604	0.354	27.79	6.198	0.916	0.043	0.168	2.76	28.67
LAB OFFICE	LDR-Nerfacto	20.87	0.645	0.431	25.62	6.349	0.925	0.199	0.377	5.08	27.66
	PanoHDR-Nerfacto	20.86	0.626	0.454	28.85	6.687	0.928	0.163	0.196	5.68	29.44
	HDR-Nerfacto	19.69	0.522	0.585	26.18	6.267	0.914	0.189	0.341	3.88	27.58
	PanDORA (ours)	20.72	0.639	0.426	29.89	6.792	0.927	0.117	0.129	1.44	29.46

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References

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- [1] Xin Huang, Qi Zhang, Feng Ying, Hongdong Li, Xuan Wang, and Qing Wang. HDR-NeRF: High dynamic range neural radiance fields. In *IEEE/CVF Conf. Comput. Vis. Pattern Recog.*, 2022. [1](#)