

PanDORA: Casual HDR Radiance Acquisition for Indoor Scenes

Supplementary document

Supplementary Material

001 1. Quantitative results per scene

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

005 2. More details on HDR-Nerfacto

006 2.1. Implementation details

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

023 2.2. Obtaining HDR radiance

024 The radiance output of HDR-NeRF (and our implementa-
 025 tion HDR-Nerfacto) is supposed to provide us with a linear HDR
 026 radiance output suitable for reconstructing high-quality im-
 027 ages at any exposure. However, we find two significant prob-
 028 lems with this output. First, the radiance output is known
 029 only up to scale; an unknown per-channel scaling factor must
 030 be obtained for each scene as a post-processing step. Even
 031 though HDR-NeRF is trained with the unit exposure loss,
 032 which regularizes the range of radiances, the scaling factors
 033 vary widely between scenes, as shown in tab. 1. Second,
 034 even after applying this scaling, the images at all the expo-
 035 sures exhibit extreme artifacts and are far from the ground
 036 truth, as shown in the “Radiance output” rows of fig. 1. We
 037 attribute this issue to the fact that the radiance output is un-
 038 derconstrained when trained with only two non-overlapping
 039 exposures, which is always the case in our setup. Instead,
 040 we choose to combine the outputs of the tonemapper module
 041 at the well- and fast-exposed exposure, which drastically
 042 improves the reconstruction quality and provides a fairer
 043 baseline, as can be seen in the “Combined” rows of fig. 1.

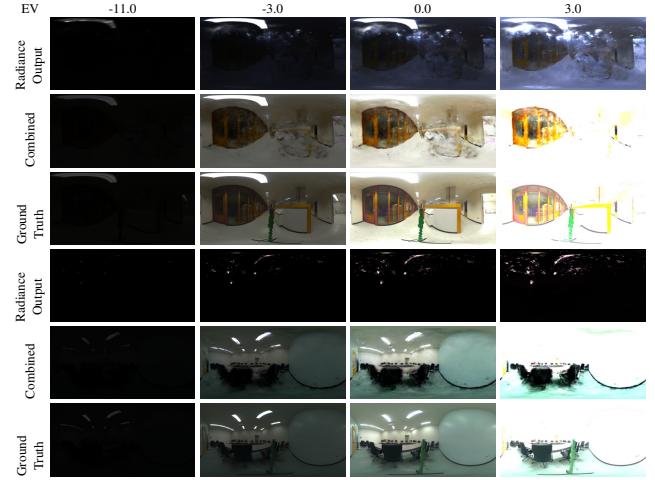


Figure 1. Comparison of the ways to evaluate a trained HDR-Nerfacto model. The radiance output of HDR-Nerfacto needs to be scaled by an unknown color balance term (which was obtained from the ground truth here) and suffers from poor image quality, generating various artifacts. Instead, we combine the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

044 **References**

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