

Online Resource 2

Per-Scene Ablation Results for “PSCD-GS: Role-Aware Perception-Structure Collaborative Densification for 3D Gaussian Splatting”

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Note. SSIM and PSNR are higher-is-better metrics, whereas LPIPS is lower-is-better. For each scene, “Delta” is calculated as the result of an ablated variant minus the result of the full model. Accordingly, negative Delta SSIM/PSNR and positive Delta LPIPS indicate degradation relative to the full model. The Average row is the arithmetic mean across all scenes in the corresponding benchmark and reproduces the dataset-level values reported in Table 3 of the main manuscript.

Table S4. Per-scene ablation results on Mip-NeRF 360.

Variant	Scene	SSIM	Delta SSIM	PSNR	Delta PSNR	LPIPS	Delta LPIPS
w/o perceptual evidence	bicycle	0.8281	-0.0092	27.4855	-0.3479	0.2001	0.0144
w/o perceptual evidence	flowers	0.8268	-0.0089	27.6539	-0.2949	0.1951	0.0120
w/o perceptual evidence	garden	0.8320	-0.0129	28.8275	0.0060	0.1927	0.0174
w/o perceptual evidence	stump	0.8278	-0.0109	27.7536	-0.3760	0.1997	0.0147
w/o perceptual evidence	treehill	0.8262	-0.0088	27.3861	-0.3260	0.2007	0.0142
w/o perceptual evidence	bonsai	0.8312	-0.0120	28.1671	-0.4302	0.1915	0.0151
w/o perceptual evidence	counter	0.8323	-0.0092	28.1081	-0.2972	0.1911	0.0121
w/o perceptual evidence	kitchen	0.8308	-0.0096	28.1231	-0.3659	0.1942	0.0138
w/o perceptual evidence	room	0.8330	-0.0067	28.0235	-0.2345	0.1908	0.0095
w/o perceptual evidence	Average	0.8298	-0.0098	27.9476	-0.2963	0.1951	0.0137
w/o structural evidence	bicycle	0.8309	-0.0064	27.6598	-0.1736	0.1948	0.0091
w/o structural evidence	flowers	0.8279	-0.0078	27.7629	-0.1859	0.1829	-0.0002
w/o structural evidence	garden	0.8336	-0.0113	28.5251	-0.2964	0.1880	0.0127
w/o structural evidence	stump	0.8291	-0.0096	27.8943	-0.2353	0.1959	0.0109
w/o structural evidence	treehill	0.8289	-0.0061	27.5495	-0.1626	0.1954	0.0089
w/o structural evidence	bonsai	0.8309	-0.0123	28.2869	-0.3104	0.1889	0.0125
w/o structural evidence	counter	0.8330	-0.0085	28.2086	-0.1967	0.1885	0.0095
w/o structural evidence	kitchen	0.8321	-0.0083	28.2663	-0.2227	0.1902	0.0098
w/o structural evidence	room	0.8335	-0.0062	28.1013	-0.1567	0.1890	0.0077
w/o structural evidence	Average	0.8311	-0.0085	28.0283	-0.2156	0.1904	0.0090
w/o soft role assignment	bicycle	0.8315	-0.0058	27.7579	-0.0755	0.1924	0.0067
w/o soft role assignment	flowers	0.8296	-0.0061	27.8780	-0.0708	0.1893	0.0062
w/o soft role assignment	garden	0.8364	-0.0085	28.7133	-0.1082	0.1839	0.0086
w/o soft role assignment	stump	0.8313	-0.0074	28.0417	-0.0879	0.1923	0.0073
w/o soft role assignment	treehill	0.8295	-0.0055	27.7161	0.0040	0.1931	0.0066
w/o soft role assignment	bonsai	0.8348	-0.0084	28.4943	-0.1030	0.1843	0.0079
w/o soft role assignment	counter	0.8351	-0.0064	28.3339	-0.0714	0.1851	0.0061

Variant	Scene	SSIM	Delta SSIM	PSNR	Delta PSNR	LPIPS	Delta LPIPS
w/o soft role assignment	kitchen	0.8340	-0.0064	28.4067	-0.0823	0.1871	0.0067
w/o soft role assignment	room	0.8348	-0.0049	28.1989	-0.0591	0.1863	0.0050
w/o soft role assignment	Average	0.8330	-0.0066	28.1712	-0.0727	0.1882	0.0068
w/o joint candidate selection	bicycle	0.8276	-0.0097	27.5140	-0.3194	0.1982	0.0125
w/o joint candidate selection	flowers	0.8251	-0.0106	27.6415	-0.3073	0.1945	0.0114
w/o joint candidate selection	garden	0.8305	-0.0144	28.3647	-0.4568	0.1904	0.0151
w/o joint candidate selection	stump	0.8263	-0.0124	27.7612	-0.3684	0.1981	0.0131
w/o joint candidate selection	treehill	0.8258	-0.0092	27.4170	-0.2951	0.1987	0.0122
w/o joint candidate selection	bonsai	0.8291	-0.0141	28.1644	-0.4329	0.1899	0.0135
w/o joint candidate selection	counter	0.8308	-0.0107	28.1058	-0.2995	0.1900	0.0110
w/o joint candidate selection	kitchen	0.8298	-0.0106	28.1468	-0.3422	0.1922	0.0118
w/o joint candidate selection	room	0.8315	-0.0082	28.0098	-0.2482	0.1904	0.0091
w/o joint candidate selection	Average	0.8285	-0.0111	27.9028	-0.3411	0.1936	0.0122
w/o region-adaptive clone/split	bicycle	0.8342	-0.0031	27.7056	-0.1278	0.1895	0.0038
w/o region-adaptive clone/split	flowers	0.8324	-0.0033	27.8298	-0.1190	0.1865	0.0034
w/o region-adaptive clone/split	garden	0.8408	-0.0041	28.6582	-0.1633	0.1795	0.0042
w/o region-adaptive clone/split	stump	0.8350	-0.0037	27.9936	-0.1360	0.1887	0.0037
w/o region-adaptive clone/split	treehill	0.8322	-0.0028	27.5952	-0.1169	0.1901	0.0036
w/o region-adaptive clone/split	bonsai	0.8393	-0.0039	28.4518	-0.1455	0.1800	0.0036
w/o region-adaptive clone/split	counter	0.8383	-0.0032	28.2959	-0.1094	0.1821	0.0031
w/o region-adaptive clone/split	kitchen	0.8374	-0.0030	28.3668	-0.1222	0.1837	0.0033
w/o region-adaptive clone/split	room	0.8398	0.0001	28.1624	-0.0956	0.1840	0.0027
w/o region-adaptive clone/split	Average	0.8366	-0.0030	28.1177	-0.1262	0.1849	0.0035
w/o role-guided split placement	bicycle	0.8352	-0.0021	27.7612	-0.0722	0.1915	0.0058
w/o role-guided split placement	flowers	0.8333	-0.0024	27.8750	-0.0738	0.1886	0.0055
w/o role-guided split placement	garden	0.8416	-0.0033	28.7095	-0.1120	0.1752	-0.0001
w/o role-guided split placement	stump	0.8357	-0.0030	28.0367	-0.0929	0.1913	0.0063
w/o role-guided split placement	treehill	0.8329	-0.0021	27.6445	-0.0676	0.1921	0.0056
w/o role-guided split placement	bonsai	0.8398	-0.0034	28.4830	-0.1143	0.1827	0.0063
w/o role-guided split placement	counter	0.8389	-0.0026	28.3281	-0.0772	0.1843	0.0053
w/o role-guided split placement	kitchen	0.8379	-0.0025	28.4034	-0.0856	0.1859	0.0055
w/o role-guided split placement	room	0.8377	-0.0020	28.1932	-0.0648	0.1860	0.0047
w/o role-guided split placement	Average	0.8370	-0.0026	28.1594	-0.0845	0.1864	0.0050
Full model	bicycle	0.8373	0.0000	27.8334	0.0000	0.1857	0.0000
Full model	flowers	0.8357	0.0000	27.9488	0.0000	0.1831	0.0000
Full model	garden	0.8449	0.0000	28.8215	0.0000	0.1753	0.0000
Full model	stump	0.8387	0.0000	28.1296	0.0000	0.1850	0.0000
Full model	treehill	0.8350	0.0000	27.7121	0.0000	0.1865	0.0000

Variant	Scene	SSIM	Delta SSIM	PSNR	Delta PSNR	LPIPS	Delta LPIPS
Full model	bonsai	0.8432	0.0000	28.5973	0.0000	0.1764	0.0000
Full model	counter	0.8415	0.0000	28.4053	0.0000	0.1790	0.0000
Full model	kitchen	0.8404	0.0000	28.4890	0.0000	0.1804	0.0000
Full model	room	0.8397	0.0000	28.2580	0.0000	0.1813	0.0000
Full model	Average	0.8396	0.0000	28.2439	0.0000	0.1814	0.0000

Table S5. Per-scene ablation results on Deep Blending.

Variant	Scene	SSIM	Delta SSIM	PSNR	Delta PSNR	LPIPS	Delta LPIPS
w/o perceptual evidence	Dr Johnson	0.9128	-0.0073	30.0197	-0.3296	0.2329	0.0119
w/o perceptual evidence	Playroom	0.9086	-0.0081	29.9117	-0.3312	0.2403	0.0127
w/o perceptual evidence	Average	0.9107	-0.0077	29.9657	-0.3304	0.2366	0.0123
w/o structural evidence	Dr Johnson	0.9129	-0.0072	30.1597	-0.1896	0.2274	0.0064
w/o structural evidence	Playroom	0.9095	-0.0072	30.0719	-0.1710	0.2340	0.0064
w/o structural evidence	Average	0.9112	-0.0072	30.1158	-0.1803	0.2307	0.0064
w/o soft role assignment	Dr Johnson	0.9146	-0.0055	30.2487	-0.1006	0.2243	0.0033
w/o soft role assignment	Playroom	0.9110	-0.0057	30.1479	-0.0950	0.2311	0.0035
w/o soft role assignment	Average	0.9128	-0.0056	30.1983	-0.0978	0.2277	0.0034
w/o joint candidate selection	Dr Johnson	0.9125	-0.0076	30.0972	-0.2521	0.2316	0.0106
w/o joint candidate selection	Playroom	0.9085	-0.0082	29.9976	-0.2453	0.2386	0.0110
w/o joint candidate selection	Average	0.9105	-0.0079	30.0474	-0.2487	0.2351	0.0108
w/o region-adaptive clone/split	Dr Johnson	0.9166	-0.0035	30.3523	0.0030	0.2268	0.0058
w/o region-adaptive clone/split	Playroom	0.9130	-0.0037	30.0605	-0.1824	0.2338	0.0062
w/o region-adaptive clone/split	Average	0.9148	-0.0036	30.2064	-0.0897	0.2303	0.0060
w/o role-guided split placement	Dr Johnson	0.9168	-0.0033	30.2006	-0.1487	0.2256	0.0046
w/o role-guided split placement	Playroom	0.9134	-0.0033	30.1118	-0.1311	0.2322	0.0046
w/o role-guided split placement	Average	0.9151	-0.0033	30.1562	-0.1399	0.2289	0.0046
Full model	Dr Johnson	0.9201	0.0000	30.3493	0.0000	0.2210	0.0000
Full model	Playroom	0.9167	0.0000	30.2429	0.0000	0.2276	0.0000
Full model	Average	0.9184	0.0000	30.2961	0.0000	0.2243	0.0000

Table S6. Per-scene ablation results on Tanks & Temples.

Variant	Scene	SSIM	Delta SSIM	PSNR	Delta PSNR	LPIPS	Delta LPIPS
w/o perceptual evidence	train	0.8722	-0.0067	24.5046	-0.1527	0.1524	0.0076
w/o perceptual evidence	truck	0.8756	-0.0085	24.3586	-0.1777	0.1466	0.0100
w/o perceptual evidence	Average	0.8739	-0.0076	24.4316	-0.1652	0.1495	0.0088
w/o structural evidence	train	0.8675	-0.0114	24.3604	-0.2969	0.1591	0.0143
w/o structural evidence	truck	0.8729	-0.0112	24.2764	-0.2599	0.1509	0.0143
w/o structural evidence	Average	0.8702	-0.0113	24.3184	-0.2784	0.1550	0.0143
w/o soft role assignment	train	0.8717	-0.0072	24.5329	-0.1244	0.1513	0.0065
w/o soft role assignment	truck	0.8761	-0.0080	24.5393	0.0030	0.1441	0.0075
w/o soft role assignment	Average	0.8739	-0.0076	24.5361	-0.0607	0.1477	0.0070
w/o joint candidate selection	train	0.8703	-0.0086	24.4061	-0.2512	0.1546	0.0098
w/o joint candidate selection	truck	0.8749	-0.0092	24.2929	-0.2434	0.1478	0.0112
w/o joint candidate selection	Average	0.8726	-0.0089	24.3495	-0.2473	0.1512	0.0105
w/o region-adaptive clone/split	train	0.8725	-0.0064	24.5857	-0.0716	0.1447	-0.0001
w/o region-adaptive clone/split	truck	0.8777	-0.0064	24.4669	-0.0694	0.1429	0.0063
w/o region-adaptive clone/split	Average	0.8751	-0.0064	24.5263	-0.0705	0.1438	0.0031
w/o role-guided split placement	train	0.8748	-0.0041	24.5511	-0.1062	0.1488	0.0040
w/o role-guided split placement	truck	0.8802	-0.0039	24.4453	-0.0910	0.1406	0.0040
w/o role-guided split placement	Average	0.8775	-0.0040	24.4982	-0.0986	0.1447	0.0040
Full model	train	0.8789	0.0000	24.6573	0.0000	0.1448	0.0000
Full model	truck	0.8841	0.0000	24.5363	0.0000	0.1366	0.0000
Full model	Average	0.8815	0.0000	24.5968	0.0000	0.1407	0.0000