

PPR10K: A Large-Scale Portrait Photo Retouching Dataset with Human-Region Mask and Group-Level Consistency

Jie Liang, Hui Zeng, Miaomiao Cui, Xuansong Xie, Lei Zhang

Dataset and code: <https://github.com/csliang/PPR10K> Email: liang27jie@gmail.com



Introduction



Special and practical requirements of portrait photo retouching (PPR):

- 1) **Human-Region Priority (HRP)**: more attention be paid to human regions
- 2) **Group-Level Consistency (GLC)**: a group of portrait photos be retouched to a consistent tone

Existing datasets (FiveK) are for general purpose without the HRP and GLC consideration.

Dataset Construction

Challenges:

- 1) photos should in raw format with high-quality, which is difficult to obtain
- 2) dataset should be large-scale and cover a wide range of real cases
- 3) high-quality retouched results with both good visual quality and group-level consistency and human-region masks should be provided

Information:

- 1) **11161 raw-format** portraits in **1681** groups (each group contains 3-18 photos)
- 2) **3 versions of GTs** for each photo manually retouched by 3 experts
- 3) Resolution ranging from **4K-8K**, DSLR **cameras** covering Canon, Nikon and Sony
- 4) Full-resolution human-region **masks** with high-quality

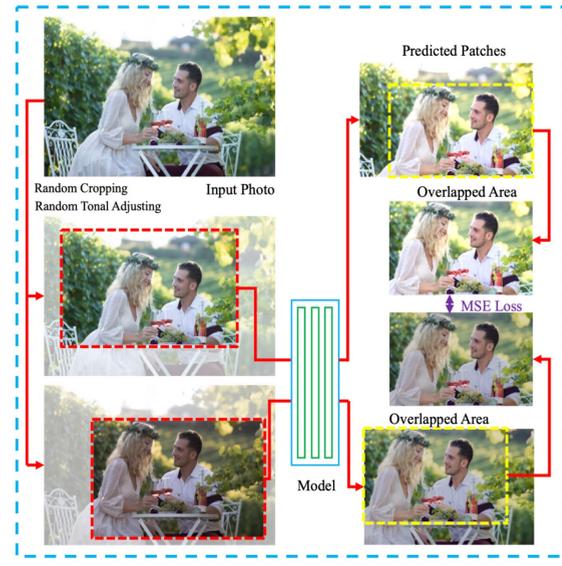
Measures and Learning Strategies

Measures:

- 1) **Basic**: $PSNR$ and $\Delta E_{ab} = \|\hat{I}^{Lab} - Y^{Lab}\|_2$, \hat{I}^{Lab} denotes the predicted photo in Lab color space, Y denotes the target.
- 2) **Human-Centered** Measures: $PSNR^{HC}$ and ΔE_{ab}^{HC} , with weight 0.5 in background regions
- 3) **Group-Level Consistency** Measure: The variance of mean color components. $\sum_c Var(\mu_{i_1^c}, \mu_{i_2^c}, \dots, \mu_{i_m^c})$
Most stable: the combination of a and b channels

Learning Strategies:

- 1) **HRP**: MSE loss with weight 5 in human regions
- 2) **GLC**: As shown in the figure, crop two partially overlapped patches and distort to mimic images in a group. Constraining overlapped region using MSE.



Experiments



Models training on FiveK obtain much worse performance than trained on the PPR10K dataset: **large domain gap!**

#	Method	Dataset	$PSNR \uparrow$		$\Delta E_{ab} \downarrow$		$PSNR^{HC} \uparrow$		$\Delta E_{ab}^{HC} \downarrow$		$M_{GLC} \downarrow$	
			LR	HR	LR	HR	LR	HR	LR	HR	LR	HR
1	HDRNet [7]	PPR10K-a	23.93	23.06	8.70	9.13	27.21	26.58	5.65	5.84	14.83	14.37
2	CSRNet [10]	PPR10K-a	22.72	22.01	9.75	10.20	25.90	25.19	6.33	6.73	12.73	12.66
3	3D LUT [32]	PPR10K-a	25.64	25.15	6.97	7.25	28.89	28.39	4.53	4.71	11.47	11.05
4	3D LUT+HRP	PPR10K-a	25.99	25.55	6.76	7.02	28.29	28.83	4.38	4.55	10.81	10.32
5	3D LUT+GLC	PPR10K-a	25.06	24.39	7.39	7.81	28.34	27.67	4.80	5.06	9.98	9.77
6	3D LUT+HRP+GLC	PPR10K-a	25.31	24.60	7.30	7.75	28.56	27.86	4.75	5.03	9.95	9.68
7	HDRNet [7]	PPR10K-b	23.96	23.51	8.84	9.13	27.21	26.55	5.74	5.92	13.21	13.04
8	CSRNet [10]	PPR10K-b	23.76	23.29	8.77	9.28	27.01	26.62	5.68	5.90	11.82	11.73
9	3D LUT [32]	PPR10K-b	24.70	24.30	7.71	7.97	27.99	27.59	4.99	5.16	9.90	9.52
10	3D LUT+HRP	PPR10K-b	25.06	24.66	7.51	7.73	28.36	27.93	4.85	5.00	9.87	9.60
11	3D LUT+GLC	PPR10K-b	24.16	23.39	8.15	8.70	27.48	26.71	5.25	5.61	9.17	8.92
12	3D LUT+HRP+GLC	PPR10K-b	24.52	23.81	7.93	8.42	27.82	27.12	5.12	5.44	9.01	8.73
13	HDRNet [7]	PPR10K-c	24.08	23.66	8.87	9.05	27.32	26.93	5.76	5.99	14.76	14.28
14	CSRNet [10]	PPR10K-c	23.17	22.85	9.45	9.87	26.47	26.09	6.12	6.54	14.64	14.22
15	3D LUT [32]	PPR10K-c	25.18	24.78	7.58	7.85	28.49	28.09	4.92	5.09	13.51	13.16
16	3D LUT+HRP	PPR10K-c	25.46	25.05	7.43	7.69	28.80	28.38	4.82	4.98	13.49	13.06
17	3D LUT+GLC	PPR10K-c	24.53	23.94	8.10	8.49	27.87	27.29	5.25	5.49	12.96	12.75
18	3D LUT+HRP+GLC	PPR10K-c	24.59	24.01	8.02	8.39	27.92	27.33	5.20	5.43	12.76	12.79

Overall comparison. **3D LUT** performs better than HDRNet and CSRNet. **HRP loss** brings better results on most individual measures. **GLC loss** improves the GLC measure yet slightly deteriorates the others. **Combining** them further improves GLC.



Visually more consistent in a group with **GLC** strategy!

Method	Dataset	$PSNR$	ΔE_{ab}	$PSNR^{HC}$	ΔE_{ab}^{HC}	M_{GLC}
HDRNet	a	18.20	17.22	21.44	11.27	20.76
CSRNet	a	19.86	14.07	23.06	9.15	13.97
3D LUT	a	19.92	13.75	23.79	8.90	13.85
HDRNet	b	18.74	16.31	22.00	10.63	20.76
CSRNet	b	19.65	14.47	22.83	9.40	13.97
3D LUT	b	19.74	14.08	23.42	9.22	13.85
HDRNet	c	19.71	14.81	22.96	9.65	20.76
CSRNet	c	19.81	14.57	23.06	9.46	13.97
3D LUT	c	20.03	13.90	23.01	8.85	13.85

Poor performance when training on FiveK and evaluating on PPR tasks!



Brighter faces and more natural temperature with **HRP** strategy!

Conclusion

A large-scale PPR dataset is constructed, with 11161 diverse raw portraits in 1681 groups. Human-region priority and group-level consistency measures and learning strategies are theoretically demonstrated and experimentally evaluated.