Spectral Painting Reproduction via Multi-Layer, Custom-Ink Printing (Supplementary Material)

LIANG SHI, MIT CSAIL
VAHID BABAEI, MIT CSAIL, MPI Informatik & Saarland University MMCI
CHANGIL KIM, MICHAEL FOSHEY, YUANMING HU, MIT CSAIL
PITCHAYA SITTHI-AMORN, Chulalongkorn University
SZYMON RUSINKIEWICZ, Princeton University
WOJCIECH MATUSIK, MIT CSAIL

This supplementary document provides further visualizations, statistics of our experimental results.

A.1 SPECTRA OF LIGHT SOURCES

Figure A.1 shows the spectra of the lighting sources we use to illuminate our results.

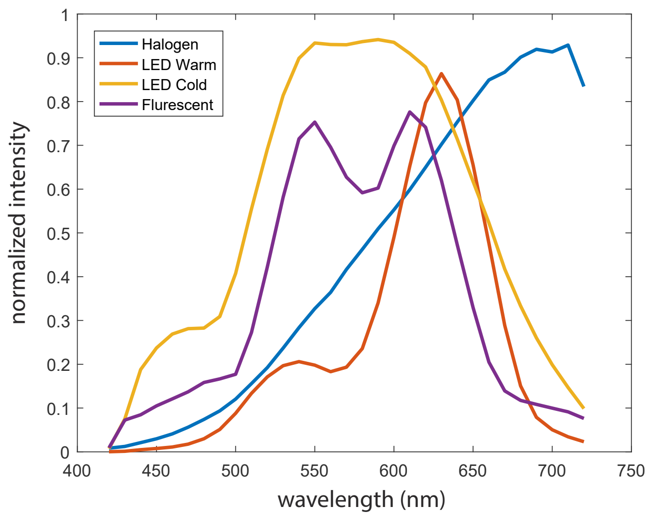

Fig. A.1. Four illumination spectra used to illuminate the result in Figure 9

A.2 EVALUATIONS ON HISTORIC PIGMENTS

Table A.1 shows the spectral error E_{spec} and the ΔE_{00} error under the D65 standard illuminant of the individual pigments in the FORS spectral database of historically important pigments [Cosentino 2014]. The rows and columns correspond to those of Figure 8.

A.3 VISUALIZATION OF TEST ERROR IN CIELAB COLOR SPACE

Figure A.2 shows the predicted spectra of the test set samples, projected onto CIELAB color space (under D65). We observe that the test error has a moderate increase at high luminance region, likely due to the relatively small number of training samples.

REFERENCES

Vahid Babaei, Kiril Vidimče, Michael Foshey, Alexandre Kaspar, Piotr Didyk, and Wojciech Matusik. 2017. Color contoning for 3D printing. *ACM Trans. Graph. (SIGGRAPH)* 36 (2017).

Antonino Cosentino. 2014. FORS Spectral Database of Historical Pigments in Different Binders. 2 (09 2014), 57–68.

Table A.1. Reproduction error of historical pigments. We show the spectral error and the ΔE_{00} error under the D65 standard illuminant of the individual pigments. R and C denote the row and column in Figure 8. Exhaustive, ours, and contoning represents the exhaustive search, our network prediction, and Babaei et al.'s contoning method [2017], respectively.

R	C	Pigment	Exhaustive		Ours		Contoning	
			E_{spec}	ΔE_{00}	E_{spec}	ΔE_{00}	E_{spec}	ΔE_{00}
1	1	burnt umber	0.20	0.46	0.44	2.91	0.73	4.58
	2	raw umber	0.25	0.35	0.25	0.35	0.43	1.51
	3	van Dyke brown	0.13	0.40	0.78	6.94	0.86	4.80
	4	burnt Sienna	0.50	0.82	0.82	2.44	2.45	7.71
	5	raw Sienna	0.46	0.88	1.13	1.47	3.24	7.10
	6	red ochre	0.61	0.92	0.91	3.34	2.78	9.71
	7	red lead	1.97	1.54	2.55	2.65	14.55	17.98
	8	cadmium red	4.88	3.93	5.67	5.86	10.99	16.20
	9	alizarin	1.92	2.98	3.01	5.64	7.20	17.43
2	1	madder lake	0.82	1.58	1.57	7.27	6.30	14.57
	2	lac dye	0.89	1.28	1.92	4.93	4.09	2.66
	3	carmine lake	2.78	7.22	2.90	10.53	5.60	15.85
	4	vermilion	0.41	0.61	1.15	2.25	4.08	9.73
	5	realgar	2.10	2.03	2.95	3.01	10.40	9.86
	6	yellow lake	0.85	0.64	1.26	2.80	2.60	4.30
	7	massicot	5.64	4.21	4.68	7.48	2.15	2.09
	8	yellow ochre	0.78	1.28	1.26	1.87	3.76	6.51
	9	gamboge	3.19	4.41	3.57	7.34	8.71	11.58
3	1	Naples yellow	4.28	2.18	3.67	5.50	3.59	2.08
	2	lead tin yellow II	4.27	1.21	4.27	1.21	4.66	2.59
	3	lead tin yellow I	7.17	4.79	7.17	4.79	2.41	0.92
	4	saffron	6.62	2.51	7.10	5.60	7.94	6.74
	5	orpiment	3.95	2.58	3.84	4.21	3.78	2.25
	6	cobalt yellow	4.24	2.13	4.43	3.61	4.96	3.89
	7	cadmium yellow	6.55	4.08	6.55	4.08	6.16	2.79
	8	chrome green	2.42	2.65	2.63	7.04	4.07	4.16
	9	cobalt green	1.11	0.75	1.49	1.67	0.95	0.60
4	1	cadmium green	1.08	0.39	1.08	0.39	3.21	4.09
	2	green earth	0.32	0.34	0.63	4.39	0.67	0.81
	3	viridian	0.62	1.02	0.93	3.92	0.80	0.73
	4	phthalo green	2.12	13.79	2.08	15.43	2.70	13.42
	5	verdigris	0.66	0.67	1.00	2.53	0.84	0.46
	6	malachite	1.02	0.22	1.82	4.32	1.44	1.21
	7	blue bice	1.35	1.87	1.94	5.71	1.96	2.03
	8	cobalt blue	5.86	3.28	5.44	4.52	9.65	4.55
	9	azurite	0.26	0.36	0.57	2.19	1.26	2.38
5	1	Egyptian blue	1.12	0.25	1.19	2.95	2.61	4.11
	2	ultramarine	0.50	0.53	0.58	2.93	1.64	2.92
	3	phthalo blue	1.33	6.09	1.52	12.56	2.39	8.69
	4	smalt	5.10	3.63	5.91	7.40	7.66	7.63
	5	indigo	0.25	0.37	0.52	2.30	0.74	4.26
	6	Maya blue	1.01	3.74	1.60	9.94	1.61	4.42
	7	Prussian blue	1.57	5.23	1.87	17.54	2.00	7.41
	8	cobalt violet	4.25	11.17	4.62	13.66	7.47	10.43
	9	ivory black	0.17	1.16	0.93	6.01	0.92	4.62
6	1	vine black	0.19	0.67	0.15	1.04	0.56	2.99
	2	bone black	0.21	0.25	0.55	5.18	0.61	2.76
	3	lamp black	0.21	0.24	0.21	0.78	0.71	3.14
	4	gypsum	1.66	2.04	1.66	2.04	2.19	1.69
	5	chalk	1.05	1.76	1.05	1.76	1.75	2.57
	6	lead white	4.32	1.54	4.32	1.54	6.60	2.42
	7	zinc white	3.68	2.01	3.68	2.01	7.46	4.97
	8	titanium white	4.01	3.14	4.01	3.14	7.50	3.41
	9	lithopone	11.80	4.73	11.80	4.73	10.53	6.18

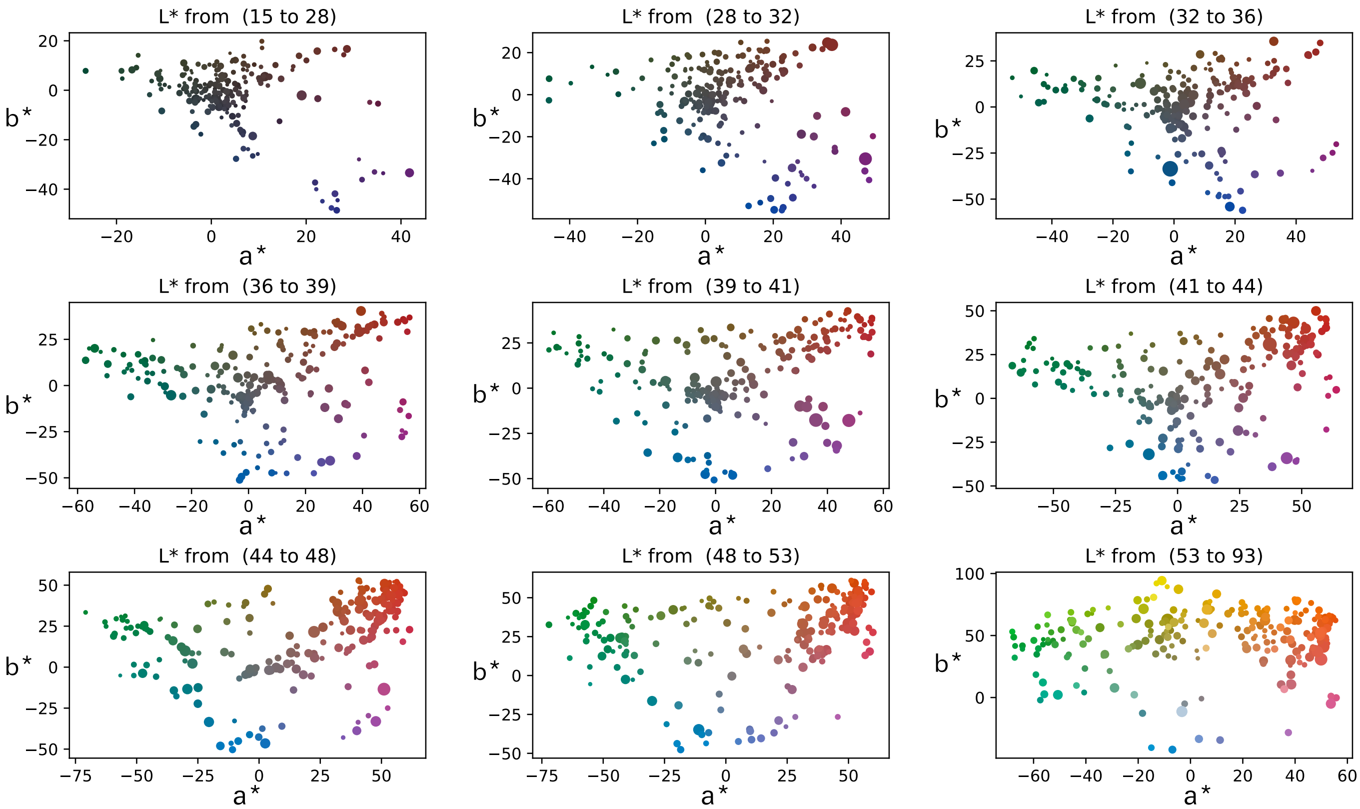

Fig. A.2. Projection of predicted spectra onto CIELAB space (under D65) with nine lightness bins. The bins are partitioned such that equal number of samples fall in each bin. The dot area proportional is to the spectral error E_{spec}, where the largest dot corresponds to $E_{\text{spec}} = 10.95\%$.