Color Coordinates of the L'Oréal Skin Color Chart (updated)

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Some time ago L'Oréal, the cosmetics company, developed and published[1] a color chart showing various shades of skin color. This was based on a sampling of the spectral reflectance characteristics of women's (healthy) skin around the world. The chart is posted as an image[2], as shown in Fig. 1. The motivation for this work was for the development of cosmetic products, and to provide understanding of expectations of consumers. In our case, we are currently interested in the requirements for, and control of, image capture for dermatologists. If we understand the importance optical (color) characteristics for an imaging application, we can tailor system design and evaluation methods for improved performance. In addition to the identification of the importance camera signal-space, the chart may provide information on system tolerances, and sources of variability.

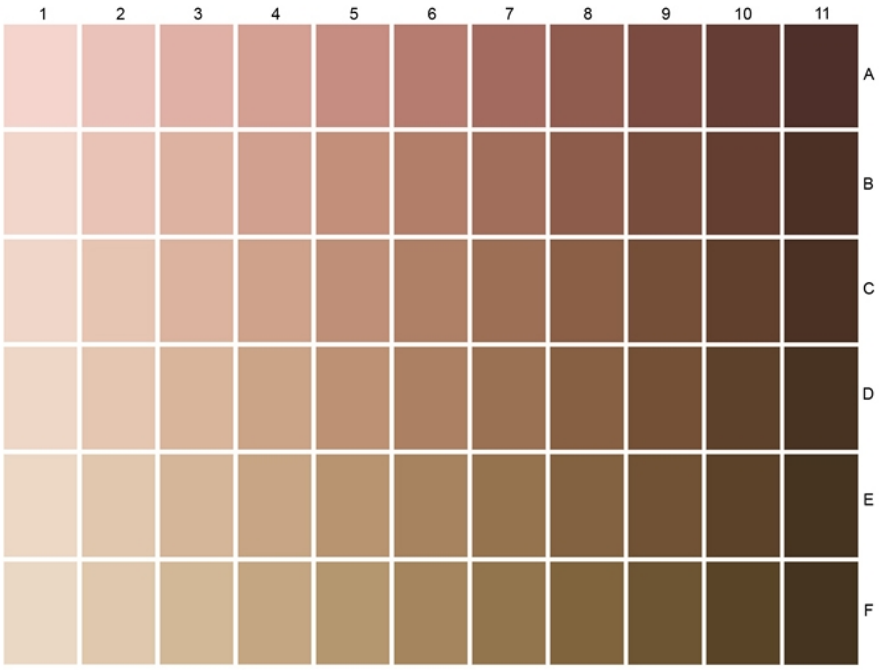

Figure 1: L'Oréal skin color chart[2]

sRGB Signal Coordinates

The posted skin color chart is posted as an sRGB-encoded image, as verified by Franck Giron, L'Oréal. *sRGB* is the default color space for most consumer and off-the-shelf imaging equipment and Fig. 2 shows these coordinates extracted from the posted image file. As expected, the set occupies a fairly narrow region around a simple function in RGB signal-space.

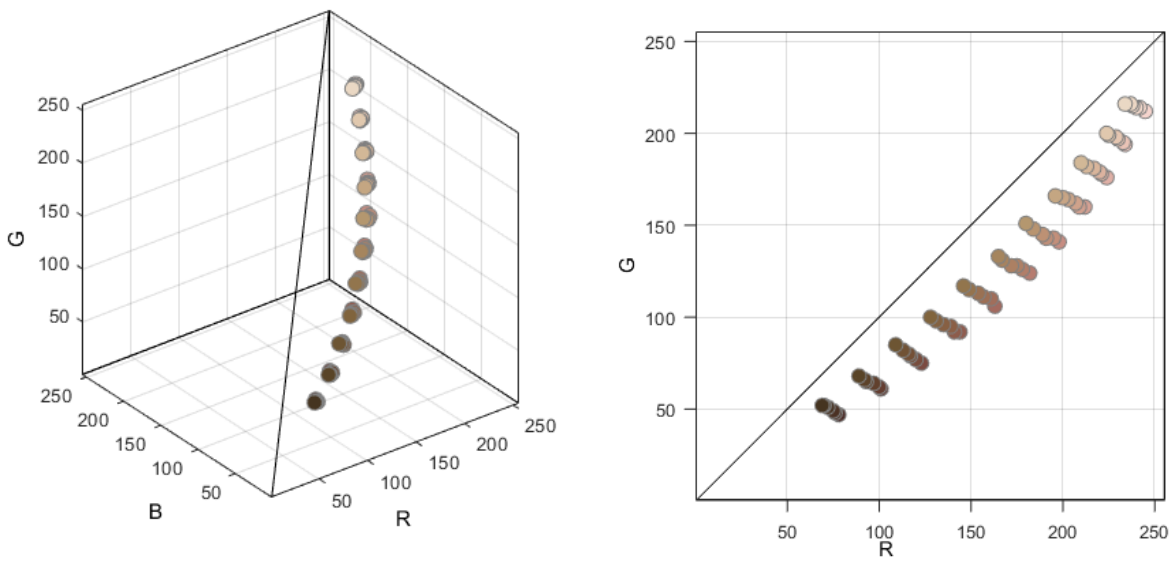

Figure 2: R,G,B coordinates for the color chart, where the line indicates the (grey) neutrals

CIELAB Coordinates

We can transform the sRGB coordinates into the corresponding values CIELAB, an approximately uniform color space. The results for a CIE D50 illuminant are shown in Fig. 3.

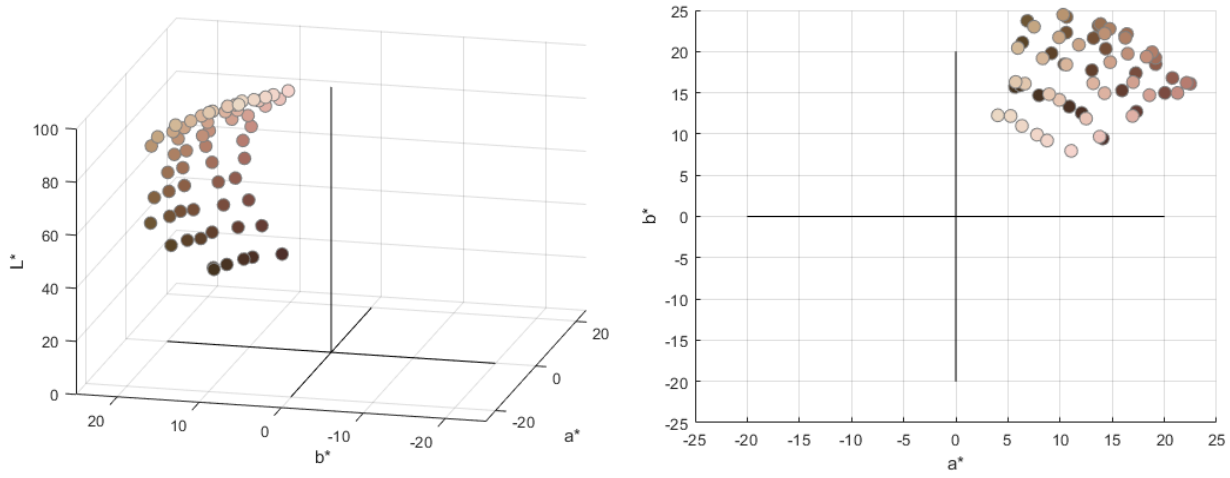

Figure 3: CIELAB coordinates for skin color chart (D50 illuminant)

Discussion

The above identification of important regions of color-space and the corresponding image signal-space are useful in several ways. Design and optimization of the image capture hardware and software can proceed with a focus on areas where user sensitivity is highest, e.g., where variation due to field conditions (lighting, camera positioning) is most visible to the dermatologist. The application of error-propagation techniques [3] can provide a useful framework. In addition, important color-regions can be used directly to build (with care) application-specific ICC color profiles.[4]

A related area is quality assurance as part of manufacturing. Examples include final system test and qualification which are likely to include measures of (image) color accuracy and variability. To this end, custom test charts[5] can be used, in combination with corresponding analysis software.

See table on the next page the sRGB and CIELAB coordinates for each patch. The order is left-to-right, starting at the top row.

Acknowledgements
Many thanks to Sheldon Bish and Franck Giron, of L'Oréal, for connections and information

References

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2. L'Oréal Company, A New Geography of Skin Color, posted at http://www.loreal.com/research-innovation/when-the-diversity-of-types-of-beauty-inspires-science/expert-in-skin-and-hair-types-around-the-world.aspx
3. P. D. Burns, Variation and Calibration Error in Electronic Imaging, *Proc. PICS Conf*., 152-155, IS&T, 2002.
4. G. Trumpy, Digital Reproduction of Small Gamut Object: A Profiling Procedure based on Custom Colour Targets, *Proc. CGIV Conf*., 143-147, IS&T, 2010.
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Please contact the author for more information on the specifics of this effort and related topics.

sRGB			CIELAB (D50)			CIELAB (D55)		
R	G	B	L*	a*	b*	L*	a*	b*
245	212	205	87.59	11.06	7.96	87.53	10.84	7.86
234	194	186	81.82	13.79	9.67	81.75	13.53	9.55
224	176	166	76.09	16.94	12.19	76.00	16.64	12.04
212	160	147	70.61	18.56	14.70	70.51	18.21	14.54
198	141	130	64.17	21.25	14.98	64.06	20.92	14.79
182	124	112	57.89	22.12	16.20	57.77	21.78	16.00
163	106	95	50.89	22.47	16.09	50.78	22.15	15.89
144	92	79	44.74	20.77	16.79	44.62	20.44	16.60
123	75	65	37.43	20.04	14.99	37.33	19.77	14.81
101	61	53	30.54	17.31	12.71	30.45	17.08	12.55
78	47	42	23.25	14.09	9.45	23.18	13.91	9.33
242	214	203	87.77	8.75	9.21	87.71	8.48	9.12
233	195	182	81.89	12.49	11.88	81.81	12.16	11.76
221	178	161	76.17	14.27	14.95	76.08	13.87	14.81
209	160	143	70.22	17.00	16.29	70.11	16.60	16.13
195	143	122	64.17	18.28	19.36	64.06	17.83	19.19
178	126	105	57.77	18.82	19.92	57.66	18.37	19.74
161	110	91	51.55	19.13	19.23	51.43	18.72	19.05
141	92	75	44.27	19.16	18.47	44.16	18.79	18.30
120	77	61	37.45	17.26	17.37	37.35	16.91	17.21
100	62	49	30.58	15.94	15.27	30.49	15.64	15.12
76	48	37	23.13	12.06	12.55	23.06	11.81	12.44
240	214	201	87.55	7.79	9.92	87.50	7.49	9.84
230	197	178	82.02	9.93	14.13	81.95	9.53	14.03
220	179	159	76.28	13.17	16.15	76.19	12.74	16.02
207	162	139	70.42	14.80	18.71	70.32	14.32	18.57
191	143	120	63.69	16.48	19.73	63.58	16.01	19.58
175	128	102	57.87	16.25	21.66	57.75	15.75	21.50
157	111	85	51.21	16.41	22.13	51.10	15.92	21.97
139	95	70	44.69	16.23	21.89	44.58	15.77	21.74
117	79	56	37.49	14.38	20.34	37.39	13.95	20.21
97	64	45	30.63	13.04	17.73	30.54	12.68	17.61
75	49	36	23.25	10.87	13.33	23.18	10.59	13.23
238	215	199	87.59	6.33	10.98	87.53	6.00	10.91
229	198	177	82.16	8.95	14.83	82.08	8.52	14.73
217	181	155	76.41	10.60	18.41	76.32	10.10	18.30
203	164	135	70.44	11.80	20.82	70.34	11.26	20.70
189	145	116	63.90	14.27	22.18	63.79	13.72	22.03
172	128	99	57.48	14.75	22.75	57.36	14.21	22.60

154	113	83	51.33	13.87	23.33	51.22	13.33	23.20
135	96	67	44.40	13.68	23.14	44.29	13.17	23.01
116	80	54	37.59	13.20	21.63	37.49	12.74	21.51
93	65	43	30.33	10.40	18.46	30.25	9.99	18.36
72	51	34	23.38	7.98	14.69	23.31	7.64	14.61
237	216	197	87.71	5.25	12.18	87.65	4.88	12.11
225	199	174	81.98	6.61	16.11	81.91	6.14	16.02
213	182	153	76.24	8.33	19.17	76.15	7.80	19.08
200	165	133	70.35	9.90	21.72	70.25	9.32	21.61
184	148	112	64.06	10.29	24.46	63.96	9.67	24.35
167	131	95	57.62	10.70	25.03	57.52	10.09	24.92
149	115	78	51.20	10.21	25.84	51.09	9.59	25.74
131	98	65	44.42	10.62	24.19	44.31	10.06	24.08
113	82	53	37.73	10.59	22.29	37.64	10.09	22.19
92	66	41	30.45	9.17	19.79	30.37	8.73	19.71
70	52	32	23.38	6.18	15.90	23.32	5.81	15.84
234	216	196	87.43	4.03	12.27	87.38	3.65	12.21
224	200	174	82.14	5.74	16.31	82.07	5.26	16.23
210	184	151	76.43	5.95	20.44	76.34	5.37	20.36
196	166	130	70.16	7.49	23.00	70.07	6.87	22.91
180	151	111	64.41	6.98	25.36	64.31	6.31	25.28
165	133	94	57.91	8.70	25.91	57.81	8.05	25.81
146	117	77	51.38	7.73	26.55	51.28	7.07	26.46
128	100	61	44.55	7.85	26.53	44.45	7.22	26.45
109	85	51	38.05	6.85	23.72	37.96	6.29	23.65
89	68	39	30.62	6.37	21.09	30.54	5.88	21.03
69	52	32	23.25	5.68	15.70	23.19	5.31	15.65