

# Hyperspectral Super-Resolution with Spectral Unmixing Constraints

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Brief Report

# Hyperspectral Super-Resolution with Spectral Unmixing Constraints – Supplementary Material

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## 1. Additional CAVE/Harvard results

Here we present some additional results (quantitative and qualitative).

**Table 1.** RMSE for the CAVE database.

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	balloons	22.37	3.27	3.49	2.23	2.37	2.10
2	beads	37.47	7.66	8.47	10.70	6.71	7.97
3	cd	19.07	9.22	9.82	8.10	6.37	7.52
4	chart_and_stuffed_toy	33.52	4.66	3.95	4.27	5.37	3.24
5	clay	17.96	2.75	3.54	2.67	2.02	1.76
6	cloth	23.37	6.75	5.53	8.21	6.43	4.32
7	egyptian_statue	14.81	1.89	1.75	2.22	1.88	1.59
8	face	18.43	3.59	2.29	2.80	2.37	2.12
9	fake_and_real_beers	21.85	3.21	3.43	2.69	2.94	2.85
10	fake_and_real_food	22.42	4.97	4.30	3.74	3.09	2.90
11	fake_and_real_lemon_slices	19.47	4.33	3.39	4.58	2.60	2.59
12	fake_and_real_lemons	17.87	2.50	3.82	2.28	1.92	1.46
13	fake_and_real_peppers	21.76	4.12	3.88	2.70	2.67	2.94
14	fake_and_real_strawberries	18.77	3.59	3.25	2.65	2.38	1.76
15	fake_and_real_sushi	15.88	4.26	3.93	4.56	2.85	3.27
16	fake_and_real_tomatoes	15.11	3.31	3.09	3.74	3.83	2.24
17	feathers	30.66	5.57	6.00	3.87	3.47	3.42
18	flowers	22.22	4.63	4.09	2.97	2.90	2.39
19	glass_tiles	26.42	5.42	5.24	5.34	3.93	4.53
20	hairs	24.10	3.56	3.01	2.54	2.49	2.26
21	jelly_beans	38.89	7.11	6.67	8.13	7.49	4.71
22	oil_painting	23.56	4.02	3.76	3.98	3.42	2.76
23	paints	43.78	5.66	6.27	6.70	5.89	4.55
24	photo_and_face	18.80	2.72	2.60	2.99	2.41	2.42
25	pompoms	31.67	5.41	6.66	4.86	4.15	3.20
26	real_and_fake_apples	15.55	2.78	3.26	2.31	1.92	1.58
27	real_and_fake_peppers	21.39	3.13	4.09	2.60	2.29	1.75
28	sponges	30.91	3.72	6.22	2.90	2.76	2.44
29	stuffed_toys	29.59	5.13	5.05	4.52	4.06	4.37
30	superballs	16.85	4.39	3.78	3.15	2.48	2.90
31	thread_spools	21.20	5.35	4.96	3.82	4.11	3.48
32	watercolors	36.68	4.40	4.46	4.39	3.87	3.40
<i>Average</i>		24.14	4.47	4.50	4.16	3.54	3.15

**Table 2.** ERGAS for the CAVE database.

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	balloons	1.905	0.281	0.302	0.193	0.200	0.179
2	beads	3.712	0.840	0.852	1.335	0.698	0.958
3	cd	3.484	1.385	1.527	1.404	1.101	1.341
4	chart_and_stuffed_toy	2.564	0.405	0.375	0.363	0.435	0.271
5	clay	3.544	0.611	0.789	1.148	0.568	0.370
6	cloth	2.197	0.415	0.359	0.618	0.406	0.282
7	egyptian_statue	4.351	0.571	0.537	0.657	0.576	0.464
8	face	2.722	0.541	0.392	0.444	0.367	0.332
9	fake_and_real_beers	0.904	0.145	0.171	0.118	0.127	0.123
10	fake_and_real_food	4.519	0.872	0.703	0.838	0.585	0.523
11	fake_and_real_lemon_slices	3.560	0.764	0.612	0.879	0.475	0.480
12	fake_and_real_lemons	2.819	0.344	0.514	0.349	0.283	0.218
13	fake_and_real_peppers	4.075	0.677	0.642	0.616	0.548	0.505
14	fake_and_real_strawberries	3.221	0.569	0.502	0.445	0.382	0.273
15	fake_and_real_sushi	5.962	1.215	0.975	1.694	0.924	1.049
16	fake_and_real_tomatoes	5.193	0.890	0.821	1.745	1.621	0.862
17	feathers	3.029	0.583	0.618	0.404	0.365	0.351
18	flowers	3.469	0.645	0.536	0.513	0.502	0.315
19	glass_tiles	2.855	0.542	0.541	0.575	0.398	0.463
20	hairs	3.129	0.457	0.387	0.336	0.328	0.295
21	jelly_beans	3.747	0.604	0.547	0.822	0.717	0.410
22	oil_painting	2.270	0.377	0.364	0.385	0.326	0.261
23	paints	2.802	0.374	0.411	0.432	0.380	0.288
24	photo_and_face	3.989	0.604	0.580	0.660	0.524	0.528
25	pompoms	2.321	0.420	0.500	0.375	0.318	0.242
26	real_and_fake_apples	4.158	0.580	0.611	0.604	0.439	0.351
27	real_and_fake_peppers	2.768	0.352	0.479	0.337	0.283	0.220
28	sponges	1.479	0.215	0.362	0.166	0.149	0.146
29	stuffed_toys	2.972	0.510	0.504	0.461	0.403	0.437
30	superballs	3.930	1.278	0.767	0.981	0.609	0.661
31	thread_spools	3.185	0.653	0.579	0.538	0.491	0.427
32	watercolors	1.262	0.169	0.173	0.161	0.144	0.125
<i>Average</i>		<i>3.191</i>	<i>0.590</i>	<i>0.563</i>	<i>0.644</i>	<i>0.490</i>	<b><i>0.430</i></b>

**Table 3.** SAM for the CAVE database.

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	balloons	10.61	10.27	10.06	4.73	4.39	3.76
2	beads	28.05	15.64	17.08	15.28	8.37	8.25
3	cd	11.93	21.44	27.36	6.88	6.70	6.14
4	chart_and_stuffed_toy	18.90	19.52	15.06	9.17	12.64	9.08
5	clay	21.89	29.09	28.91	11.53	7.73	7.91
6	cloth	12.83	6.82	5.84	7.66	5.72	4.39
7	egyptian_statue	24.95	28.58	25.14	12.21	11.89	9.08
8	face	15.68	18.17	16.42	6.81	7.72	7.00
9	fake_and_real_beers	4.52	2.46	2.78	1.96	1.71	1.86
10	fake_and_real_food	17.71	25.53	23.02	11.15	7.54	7.62
11	fake_and_real_lemon_slices	15.29	23.67	22.17	11.16	7.88	6.21
12	fake_and_real_lemons	13.65	8.91	25.17	5.18	4.71	4.28
13	fake_and_real_peppers	17.11	24.84	23.96	9.90	6.48	7.22
14	fake_and_real_strawberries	15.08	26.46	24.93	8.46	6.43	6.25
15	fake_and_real_sushi	10.15	24.11	28.23	7.10	4.80	6.83
16	fake_and_real_tomatoes	14.72	27.74	31.03	7.63	7.05	5.73
17	feathers	16.52	20.67	18.91	8.27	7.05	6.90
18	flowers	21.18	24.16	24.85	12.47	12.89	9.85
19	glass_tiles	15.98	16.73	16.11	9.48	5.58	5.54
20	hairs	11.94	18.95	14.62	5.26	5.00	4.74
21	jelly_beans	21.55	19.68	18.24	15.78	9.36	7.56
22	oil_painting	15.21	13.29	13.15	7.49	7.33	4.74
23	paints	16.00	12.31	15.08	8.28	7.36	7.05
24	photo_and_face	17.92	20.33	19.15	11.87	10.06	8.47
25	pompoms	18.40	10.04	12.06	7.84	5.07	4.21
26	real_and_fake_apples	13.49	18.49	28.12	6.48	5.60	5.48
27	real_and_fake_peppers	14.34	8.85	20.61	5.12	4.70	4.26
28	sponges	11.38	7.03	9.43	4.08	3.09	3.62
29	stuffed_toys	20.34	21.95	18.94	10.89	14.56	12.01
30	superballs	17.07	19.98	27.47	10.47	7.78	7.02
31	thread_spools	16.71	24.56	23.05	9.57	7.36	9.24
32	watercolors	11.12	9.84	9.83	5.39	4.66	4.44
<i>Average</i>		<i>16.01</i>	<i>18.13</i>	<i>19.27</i>	<i>8.61</i>	<i>7.16</i>	<b><i>6.46</i></b>

**Table 4.**  $Q2^n$  for the CAVE database.

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	balloons	0.881	0.951	0.949	0.964	0.951	0.960
2	beads	0.495	0.870	0.864	0.781	0.859	0.868
3	cd	0.921	0.947	0.950	0.950	0.951	0.952
4	chart_and_stuffed_toy	0.793	0.908	0.925	0.929	0.906	0.916
5	clay	0.778	0.875	0.853	0.898	0.897	0.899
6	cloth	0.297	0.594	0.679	0.566	0.608	0.691
7	egyptian_statue	0.966	0.982	0.981	0.978	0.979	0.978
8	face	0.886	0.937	0.963	0.953	0.964	0.967
9	fake_and_real_beers	0.747	0.846	0.860	0.876	0.848	0.861
10	fake_and_real_food	0.876	0.909	0.919	0.919	0.921	0.943
11	fake_and_real_lemon_slices	0.952	0.974	0.979	0.969	0.978	0.982
12	fake_and_real_lemons	0.938	0.958	0.973	0.971	0.968	0.977
13	fake_and_real_peppers	0.885	0.933	0.939	0.952	0.949	0.954
14	fake_and_real_strawberries	0.950	0.981	0.981	0.980	0.967	0.982
15	fake_and_real_sushi	0.963	0.971	0.982	0.967	0.984	0.981
16	fake_and_real_tomatoes	0.918	0.962	0.971	0.955	0.958	0.965
17	feathers	0.817	0.915	0.926	0.931	0.918	0.936
18	flowers	0.822	0.887	0.905	0.921	0.935	0.928
19	glass_tiles	0.763	0.942	0.938	0.921	0.944	0.948
20	hairs	0.834	0.941	0.952	0.946	0.936	0.949
21	jelly_beans	0.732	0.905	0.877	0.884	0.877	0.925
22	oil_painting	0.831	0.948	0.952	0.935	0.945	0.959
23	paints	0.689	0.892	0.889	0.879	0.877	0.905
24	photo_and_face	0.974	0.987	0.988	0.987	0.986	0.988
25	pompoms	0.703	0.863	0.845	0.862	0.837	0.892
26	real_and_fake_apples	0.958	0.983	0.980	0.988	0.987	0.983
27	real_and_fake_peppers	0.900	0.959	0.953	0.963	0.958	0.973
28	sponges	0.673	0.767	0.729	0.834	0.816	0.833
29	stuffed_toys	0.752	0.883	0.877	0.887	0.871	0.892
30	superballs	0.899	0.944	0.955	0.951	0.952	0.948
31	thread_spools	0.840	0.890	0.899	0.903	0.908	0.916
32	watercolors	0.494	0.771	0.769	0.789	0.787	0.819
<i>Average</i>		<i>0.810</i>	<i>0.909</i>	<i>0.913</i>	<i>0.912</i>	<i>0.913</i>	<b><i>0.927</i></b>

**Table 5.** RMSE for the Harvard database (Images 1-50).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	img1	24.62	2.05	1.99	2.04	2.44	1.85
2	img2	22.59	2.43	2.47	2.81	2.17	2.31
3	img3	6.08	1.91	1.73	1.45	1.13	0.96
4	img4	4.51	1.04	0.84	1.05	0.70	0.81
5	img5	8.14	1.55	0.93	1.47	0.98	0.75
6	img6	8.44	1.32	1.30	1.33	1.12	0.89
7	imga1	14.69	2.26	1.83	1.84	2.08	1.38
8	imga2	8.95	1.08	1.13	1.05	1.02	0.87
9	imga3	14.63	6.93	5.19	3.47	2.55	3.41
10	imga4	7.27	2.64	2.61	2.04	1.31	2.31
11	imga5	4.66	0.91	0.93	1.37	0.90	1.59
12	imga6	10.62	2.71	2.47	1.99	1.81	1.91
13	imga7	8.71	1.55	1.83	1.75	1.69	1.54
14	imga8	5.03	2.99	2.50	1.87	1.12	1.64
15	imgb0	12.64	2.17	2.15	2.01	1.61	1.57
16	imgb1	19.05	1.97	2.02	2.24	2.01	1.88
17	imgb2	20.59	2.04	1.63	2.59	1.61	2.20
18	imgb3	21.50	3.84	3.28	3.35	2.54	2.29
19	imgb4	12.34	4.96	4.26	4.35	3.58	4.14
20	imgb5	20.34	1.59	1.65	1.57	2.04	1.40
21	imgb6	15.03	3.52	3.44	3.27	2.84	2.60
22	imgb7	21.70	9.11	5.46	5.37	4.64	5.00
23	imgb8	21.75	4.26	3.55	3.19	2.59	2.29
24	imgb9	12.61	1.82	2.02	2.06	1.83	1.77
25	imgc1	11.82	2.06	1.86	1.79	1.58	1.43
26	imgc2	14.66	3.79	2.77	2.83	2.99	2.41
27	imgc3	9.88	1.51	1.52	1.57	1.43	1.80
28	imgc4	15.90	2.25	1.63	2.15	1.55	1.53
29	imgc5	18.72	2.13	2.10	2.09	2.27	2.00
30	imgc6	12.88	1.67	1.45	1.46	1.34	1.35
31	imgc7	21.55	2.27	2.11	2.56	2.32	1.95
32	imgc8	18.91	4.97	4.12	3.27	2.53	3.79
33	imgc9	15.22	2.71	3.19	3.59	2.61	2.77
34	imgd0	19.52	3.93	4.31	3.29	2.82	2.54
35	imgd1	10.36	1.63	1.13	1.53	1.47	0.82
36	imgd2	12.25	0.99	1.14	1.73	1.13	1.32
37	imgd3	16.32	1.24	1.34	2.27	3.38	1.17
38	imgd4	10.93	1.18	1.14	1.27	1.63	1.09
39	imgd5	10.01	3.51	1.92	2.56	1.57	1.69
40	imgd6	7.11	2.07	2.37	2.12	1.01	0.92
41	imgd7	15.51	1.91	1.61	1.96	1.54	1.28
42	imgd8	18.01	3.10	2.69	1.85	1.99	1.45
43	imgd9	8.66	1.80	1.82	1.33	1.48	1.22
44	imge0	8.13	1.59	1.56	1.66	1.28	1.35
45	imge1	23.68	7.70	7.69	7.78	7.87	7.59
46	imge2	15.14	5.90	6.08	6.47	5.78	5.77
47	imge3	19.09	1.88	1.86	2.67	1.82	1.53
48	imge4	12.30	1.62	1.48	1.53	1.31	1.26
49	imge5	22.02	2.64	2.34	2.42	2.89	2.19
50	imge6	17.57	2.06	2.15	2.98	1.88	1.78

**Table 6.** RMSE for the Harvard database (Images 51-77).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
51	imge7	15.68	1.64	1.82	1.86	1.81	1.59
52	imgf1	19.59	4.24	3.54	3.28	3.51	2.89
53	imgf2	19.69	2.41	2.07	3.11	2.29	2.04
54	imgf3	17.28	3.25	2.75	3.67	2.72	2.20
55	imgf4	17.89	1.42	1.35	2.53	1.82	1.34
56	imgf5	9.44	1.15	1.23	2.45	1.34	1.92
57	imgf6	4.70	1.84	1.92	1.54	1.12	1.38
58	imgf7	17.76	1.56	1.56	2.19	2.06	1.32
59	imgf8	9.75	1.71	1.62	3.21	1.41	1.53
60	imgg0	8.32	1.33	1.18	1.86	0.97	0.80
61	imgg1	7.72	1.75	1.47	1.34	1.17	0.96
62	imgg2	5.10	1.77	1.30	1.16	0.73	0.73
63	imgg3	8.01	1.27	1.11	1.05	1.11	0.95
64	imgg4	7.01	1.49	1.33	1.59	1.26	0.87
65	imgg5	11.11	2.08	1.92	1.62	1.65	1.35
66	imgg6	3.91	2.29	2.18	2.15	2.15	2.11
67	imgg7	11.79	3.07	2.80	2.15	2.00	1.78
68	imgg8	6.60	1.50	1.26	1.17	0.83	0.78
69	imgg9	5.51	1.13	0.97	1.18	0.78	0.70
70	imgh0	19.55	2.83	3.04	2.85	2.55	2.27
71	imgh1	9.10	1.06	0.94	1.14	0.92	0.91
72	imgh2	15.54	1.54	1.33	3.16	1.37	1.23
73	imgh3	6.76	1.47	1.35	1.71	1.04	2.04
74	imgh4	9.06	2.91	1.78	1.48	1.25	1.25
75	imgh5	8.36	5.49	2.74	1.85	1.29	1.44
76	imgh6	8.10	2.10	2.17	1.03	1.52	0.99
77	imgh7	2.90	0.88	0.69	0.83	0.69	0.66
<i>Average</i>		<i>12.97</i>	<i>2.47</i>	<i>2.18</i>	<i>2.28</i>	<i>1.91</i>	<i>1.81</i>

Table 7. ERGAS for the Harvard database (Images 1-50).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	img1	1.239	0.138	0.141	0.132	0.148	0.126
2	img2	1.950	0.241	0.276	0.307	0.228	0.251
3	img3	1.113	0.464	0.471	0.354	0.286	0.264
4	img4	1.237	0.614	0.517	0.410	0.335	0.349
5	img5	1.531	0.477	0.461	0.364	0.302	0.279
6	img6	1.631	0.634	0.672	0.456	0.400	0.384
7	imga1	1.283	0.257	0.187	0.211	0.214	0.147
8	imga2	1.739	0.354	0.409	0.273	0.232	0.214
9	imga3	1.754	0.938	0.798	0.873	0.492	0.982
10	imga4	1.524	0.630	0.629	0.501	0.316	0.542
11	imga5	0.904	0.221	0.230	0.420	0.214	0.429
12	imga6	0.754	0.199	0.193	0.170	0.154	0.155
13	imga7	0.470	0.110	0.122	0.120	0.115	0.105
14	imga8	1.926	0.918	0.770	0.968	0.557	0.915
15	imgb0	1.177	0.244	0.274	0.270	0.179	0.199
16	imgb1	0.859	0.120	0.128	0.137	0.122	0.116
17	imgb2	1.844	0.377	0.391	0.595	0.376	0.575
18	imgb3	1.861	0.332	0.316	0.451	0.304	0.339
19	imgb4	1.104	0.322	0.315	0.383	0.300	0.276
20	imgb5	1.434	0.206	0.228	0.194	0.194	0.160
21	imgb6	1.208	0.256	0.255	0.279	0.213	0.201
22	imgb7	1.920	0.563	0.422	0.510	0.406	0.390
23	imgb8	1.580	0.276	0.256	0.287	0.213	0.198
24	imgb9	0.792	0.154	0.158	0.166	0.147	0.144
25	imgc1	1.323	0.272	0.268	0.250	0.215	0.200
26	imgc2	0.843	0.267	0.199	0.186	0.200	0.180
27	imgc3	0.800	0.172	0.175	0.161	0.147	0.180
28	imgc4	1.579	0.289	0.214	0.315	0.195	0.202
29	imgc5	0.812	0.138	0.140	0.128	0.134	0.121
30	imgc6	1.153	0.209	0.198	0.172	0.166	0.159
31	imgc7	1.407	0.193	0.198	0.238	0.198	0.177
32	imgc8	1.462	0.390	0.326	0.288	0.227	0.308
33	imgc9	0.908	0.196	0.221	0.254	0.183	0.195
34	imgd0	1.309	0.302	0.291	0.271	0.239	0.239
35	imgd1	1.898	0.714	0.608	0.434	0.393	0.332
36	imgd2	2.699	0.381	0.398	0.629	0.319	0.458
37	imgd3	2.357	0.242	0.271	0.454	0.509	0.224
38	imgd4	1.211	0.188	0.176	0.185	0.206	0.160
39	imgd5	1.437	0.433	0.286	0.558	0.288	0.308
40	imgd6	1.657	0.709	0.828	0.601	0.391	0.386
41	imgd7	1.342	0.270	0.256	0.259	0.201	0.179
42	imgd8	2.154	0.497	0.428	0.379	0.297	0.258
43	imgd9	0.829	0.215	0.249	0.168	0.176	0.154
44	imge0	1.608	0.346	0.373	0.400	0.283	0.313
45	imge1	1.846	0.655	0.680	0.673	0.666	0.656
46	imge2	2.387	0.975	1.027	1.126	0.981	1.003
47	imge3	1.565	0.237	0.249	0.297	0.217	0.203
48	imge4	0.887	0.144	0.147	0.150	0.128	0.125
49	imge5	1.461	0.189	0.189	0.195	0.211	0.172
50	imge6	1.214	0.201	0.236	0.336	0.194	0.183



Table 8. ERGAS for the Harvard database (Images 51-77).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
51	imge7	1.042	0.161	0.172	0.185	0.151	0.142
52	imgf1	2.338	0.759	0.657	0.837	0.597	0.871
53	imgf2	2.972	0.435	0.426	0.565	0.386	0.375
54	imgf3	2.313	0.456	0.399	0.510	0.366	0.305
55	imgf4	1.233	0.114	0.112	0.203	0.136	0.103
56	imgf5	2.452	0.389	0.379	0.745	0.371	0.521
57	imgf6	1.684	0.723	0.700	0.664	0.403	0.456
58	imgf7	1.780	0.255	0.278	0.339	0.256	0.241
59	imgf8	1.775	0.504	0.474	1.000	0.364	0.386
60	imgg0	1.530	0.544	0.532	0.509	0.330	0.316
61	imgg1	1.335	0.675	0.591	0.431	0.377	0.365
62	imgg2	1.503	0.599	0.570	0.408	0.339	0.333
63	imgg3	1.191	0.348	0.326	0.269	0.274	0.253
64	imgg4	1.648	0.933	0.858	0.646	0.515	0.482
65	imgg5	1.196	0.536	0.505	0.385	0.383	0.341
66	imgg6	0.733	0.418	0.390	0.387	0.391	0.385
67	imgg7	1.439	0.496	0.431	0.351	0.318	0.278
68	imgg8	1.653	0.766	0.811	0.453	0.424	0.408
69	imgg9	1.221	0.693	0.627	0.471	0.385	0.376
70	imgh0	1.057	0.219	0.243	0.224	0.191	0.190
71	imgh1	2.123	0.344	0.335	0.311	0.255	0.251
72	imgh2	2.480	0.465	0.398	0.713	0.290	0.318
73	imgh3	1.208	0.504	0.339	0.467	0.262	0.496
74	imgh4	1.655	0.535	0.505	0.446	0.334	0.373
75	imgh5	1.200	0.790	0.591	0.410	0.337	0.353
76	imgh6	1.283	0.673	0.810	0.382	0.413	0.372
77	imgh7	0.979	0.449	0.354	0.372	0.354	0.354
<i>Average</i>		<i>1.481</i>	<i>0.411</i>	<i>0.390</i>	<i>0.398</i>	<b><i>0.299</i></b>	<i>0.318</i>

**Table 9.** SAM for the Harvard database (Images 1-50).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	img1	5.144	2.81	2.75	2.72	2.39	2.37
2	img2	5.218	4.19	3.91	3.97	3.09	3.12
3	img3	6.381	6.44	6.27	4.84	3.99	3.97
4	img4	4.964	5.52	4.80	3.79	3.27	3.18
5	img5	8.635	8.16	7.86	4.60	4.77	4.55
6	img6	7.739	7.47	9.25	5.62	5.03	5.08
7	imga1	5.143	4.45	3.88	3.01	2.67	2.54
8	imga2	5.125	4.36	4.96	3.79	3.03	3.15
9	imga3	6.777	10.94	7.31	3.84	3.45	3.68
10	imga4	5.495	7.89	7.82	4.50	3.33	4.16
11	imga5	2.749	1.94	2.02	2.05	1.81	1.78
12	imga6	3.712	3.71	3.46	2.61	2.37	2.49
13	imga7	2.355	1.47	1.75	1.56	1.46	1.39
14	imga8	6.667	9.79	10.00	5.21	3.99	4.20
15	imgb0	4.649	4.06	4.03	2.94	2.65	2.46
16	imgb1	3.267	1.65	1.68	1.86	1.57	1.52
17	imgb2	4.944	3.46	2.48	3.14	2.36	2.34
18	imgb3	4.657	4.50	3.99	3.48	2.45	2.57
19	imgb4	6.538	5.89	5.00	5.63	4.17	4.60
20	imgb5	3.713	2.67	2.89	2.60	2.15	2.13
21	imgb6	4.584	3.89	3.73	3.59	2.89	2.72
22	imgb7	6.483	10.33	5.94	6.29	4.38	6.04
23	imgb8	5.353	5.55	4.22	3.68	2.73	3.04
24	imgb9	3.692	2.43	2.73	2.54	2.19	2.21
25	imgc1	5.451	4.68	4.31	4.16	3.41	3.34
26	imgc2	4.010	3.17	2.17	2.06	2.26	2.01
27	imgc3	3.029	2.22	2.15	1.77	1.72	1.75
28	imgc4	4.740	4.38	3.23	3.51	2.58	2.61
29	imgc5	3.225	2.02	1.90	1.85	1.82	1.80
30	imgc6	3.486	2.84	2.53	2.55	2.32	2.26
31	imgc7	4.437	2.95	2.77	3.03	2.34	2.33
32	imgc8	5.933	5.07	5.26	4.04	2.88	3.71
33	imgc9	4.158	2.92	3.47	3.44	2.63	2.67
34	imgd0	3.725	3.61	3.46	2.54	2.21	1.94
35	imgd1	6.365	6.43	5.92	4.47	3.73	3.40
36	imgd2	7.151	4.47	6.24	4.66	3.73	3.80
37	imgd3	6.097	3.50	4.10	4.52	3.82	3.18
38	imgd4	6.229	3.67	3.54	3.29	3.00	3.05
39	imgd5	4.794	6.06	3.42	3.64	2.45	2.80
40	imgd6	7.373	7.51	12.05	5.71	4.45	4.74
41	imgd7	5.039	3.60	2.96	3.12	2.34	2.20
42	imgd8	7.789	12.70	10.74	5.35	5.06	4.55
43	imgd9	4.849	5.70	5.63	2.65	3.25	2.56
44	imge0	5.210	4.39	4.63	4.06	3.12	3.13
45	imge1	8.259	5.56	6.86	5.17	4.74	4.80
46	imge2	7.624	6.43	7.43	6.78	6.10	5.68
47	imge3	4.784	2.44	2.50	3.15	2.03	1.93
48	imge4	3.436	2.33	2.11	2.21	1.65	1.65
49	imge5	6.265	3.90	3.27	3.28	2.90	2.88
50	imge6	4.906	2.98	2.98	3.01	2.13	2.13

**Table 10.** SAM for the Harvard database (Images 51-77).

#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
51	imge7	4.132	2.76	2.91	2.75	2.53	2.45
52	imgf1	7.448	9.56	4.22	4.90	5.52	4.03
53	imgf2	8.365	6.91	5.09	6.40	4.20	4.05
54	imgf3	8.354	7.74	6.47	8.16	5.06	5.34
55	imgf4	6.651	3.44	3.13	3.38	2.99	2.59
56	imgf5	6.154	3.76	4.22	5.62	3.07	3.12
57	imgf6	6.547	8.67	9.37	6.22	4.74	5.42
58	imgf7	6.733	4.51	4.30	3.95	3.31	3.13
59	imgf8	6.868	4.84	4.80	6.82	3.96	4.06
60	imgg0	6.111	4.49	3.78	4.40	2.58	2.51
61	imgg1	6.352	8.42	6.94	4.93	4.14	4.36
62	imgg2	5.564	9.68	7.20	4.47	3.50	3.46
63	imgg3	3.006	2.38	2.09	1.74	1.59	1.55
64	imgg4	6.174	7.26	7.70	4.90	4.11	4.05
65	imgg5	3.583	3.38	3.20	2.39	2.24	2.13
66	imgg6	2.663	2.19	2.09	2.03	2.06	2.00
67	imgg7	5.685	5.64	6.84	3.94	3.26	3.90
68	imgg8	7.172	14.17	9.51	4.59	4.45	4.52
69	imgg9	4.884	4.49	4.33	3.61	2.81	2.72
70	img0	4.717	3.07	3.01	2.88	2.55	2.39
71	img1	7.421	6.85	4.77	4.35	4.21	4.49
72	img2	9.733	6.06	5.41	6.75	4.47	4.51
73	img3	4.490	3.77	3.32	3.71	2.27	2.28
74	img4	3.670	6.38	3.65	2.33	2.01	2.06
75	img5	6.126	13.40	6.98	4.01	3.19	3.60
76	img6	9.523	8.24	10.41	4.48	5.36	4.56
77	img7	2.862	2.77	1.86	2.05	1.86	1.86
	<i>Average</i>	<i>5.50</i>	<i>5.25</i>	<i>4.75</i>	<i>3.87</i>	<b><i>3.15</i></b>	<i>3.16</i>

**Table 11.**  $Q2^n$  for the Harvard database (Images 1-50).

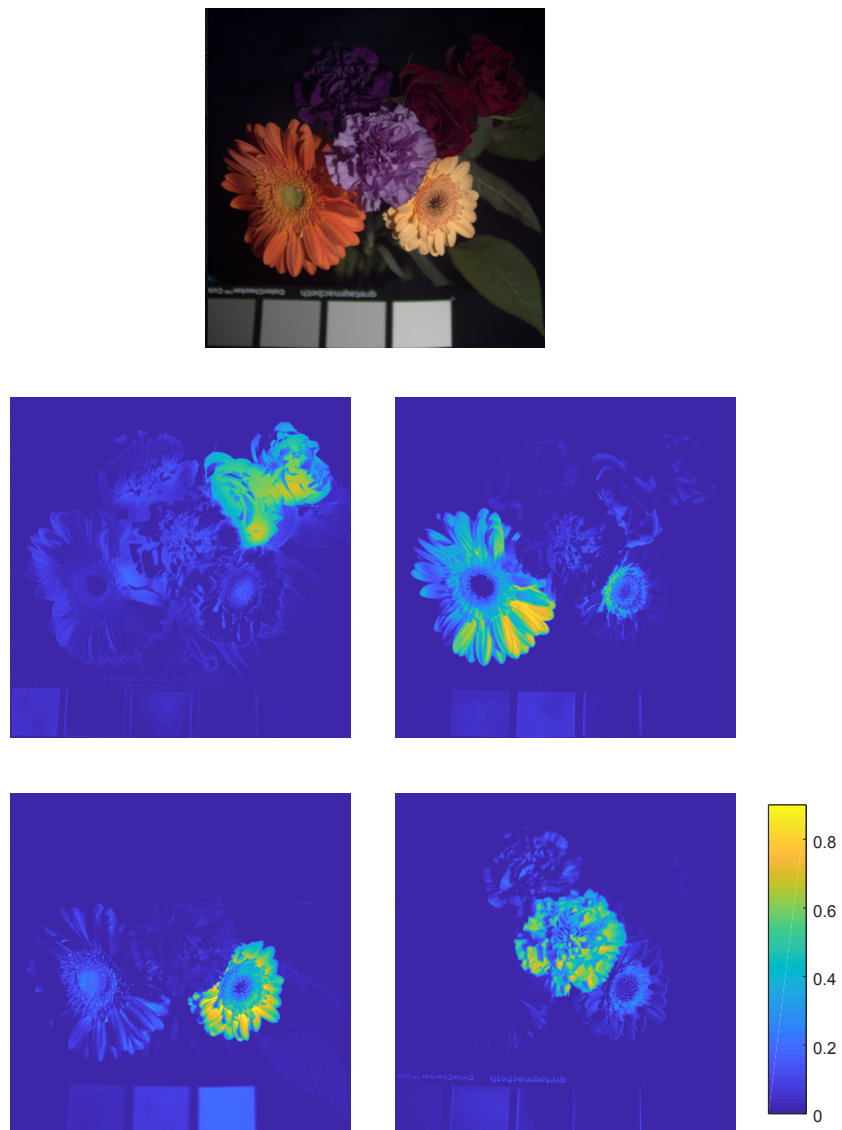
#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
1	img1	0.667	0.786	0.778	0.780	0.773	0.789
2	img2	0.812	0.953	0.950	0.947	0.950	0.952
3	img3	0.992	0.993	0.993	0.993	0.994	0.996
4	img4	0.997	0.999	0.999	0.999	0.999	0.999
5	img5	0.837	0.914	0.915	0.911	0.895	0.929
6	img6	0.939	0.970	0.977	0.971	0.971	0.982
7	imga1	0.891	0.940	0.941	0.935	0.926	0.942
8	imga2	0.979	0.991	0.992	0.991	0.987	0.992
9	imga3	0.763	0.857	0.844	0.876	0.866	0.885
10	imga4	0.981	0.988	0.987	0.987	0.989	0.989
11	imga5	0.997	0.999	0.999	0.999	0.999	0.998
12	imga6	0.884	0.964	0.966	0.966	0.965	0.973
13	imga7	0.921	0.976	0.974	0.973	0.970	0.974
14	imga8	0.997	0.997	0.998	0.998	0.998	0.997
15	imgb0	0.903	0.962	0.961	0.951	0.960	0.965
16	imgb1	0.533	0.839	0.827	0.829	0.826	0.844
17	imgb2	0.849	0.960	0.964	0.957	0.961	0.964
18	imgb3	0.791	0.889	0.916	0.906	0.906	0.924
19	imgb4	0.817	0.707	0.770	0.827	0.829	0.741
20	imgb5	0.822	0.940	0.937	0.938	0.918	0.941
21	imgb6	0.720	0.794	0.844	0.797	0.780	0.803
22	imgb7	0.556	0.634	0.701	0.734	0.744	0.709
23	imgb8	0.735	0.909	0.908	0.899	0.881	0.921
24	imgb9	0.924	0.964	0.960	0.962	0.962	0.963
25	imgc1	0.983	0.993	0.994	0.992	0.992	0.995
26	imgc2	0.356	0.587	0.646	0.629	0.560	0.695
27	imgc3	0.969	0.989	0.988	0.989	0.990	0.989
28	imgc4	0.947	0.973	0.980	0.979	0.977	0.981
29	imgc5	0.524	0.723	0.722	0.723	0.713	0.725
30	imgc6	0.917	0.952	0.954	0.953	0.955	0.956
31	imgc7	0.723	0.906	0.909	0.902	0.880	0.911
32	imgc8	0.799	0.902	0.892	0.914	0.909	0.913
33	imgc9	0.872	0.968	0.964	0.960	0.966	0.967
34	imgd0	0.418	0.673	0.698	0.735	0.739	0.755
35	imgd1	0.862	0.920	0.946	0.930	0.915	0.951
36	imgd2	0.987	0.996	0.996	0.995	0.995	0.996
37	imgd3	0.958	0.986	0.988	0.979	0.970	0.987
38	imgd4	0.942	0.961	0.961	0.960	0.949	0.961
39	imgd5	0.987	0.989	0.993	0.987	0.992	0.991
40	imgd6	0.952	0.977	0.990	0.974	0.990	0.993
41	imgd7	0.969	0.982	0.983	0.982	0.981	0.983
42	imgd8	0.878	0.939	0.941	0.937	0.935	0.942
43	imgd9	0.980	0.986	0.988	0.987	0.985	0.988
44	imge0	0.990	0.996	0.997	0.996	0.997	0.997
45	imge1	0.864	0.921	0.920	0.919	0.917	0.921
46	imge2	0.894	0.921	0.918	0.916	0.917	0.919
47	imge3	0.884	0.962	0.963	0.955	0.953	0.966
48	imge4	0.989	0.991	0.991	0.991	0.991	0.991
49	imge5	0.885	0.965	0.968	0.967	0.962	0.969
50	imge6	0.590	0.877	0.873	0.831	0.872	0.884

**Table 12.**  $Q2^n$  for the Harvard database (Images 51-77).

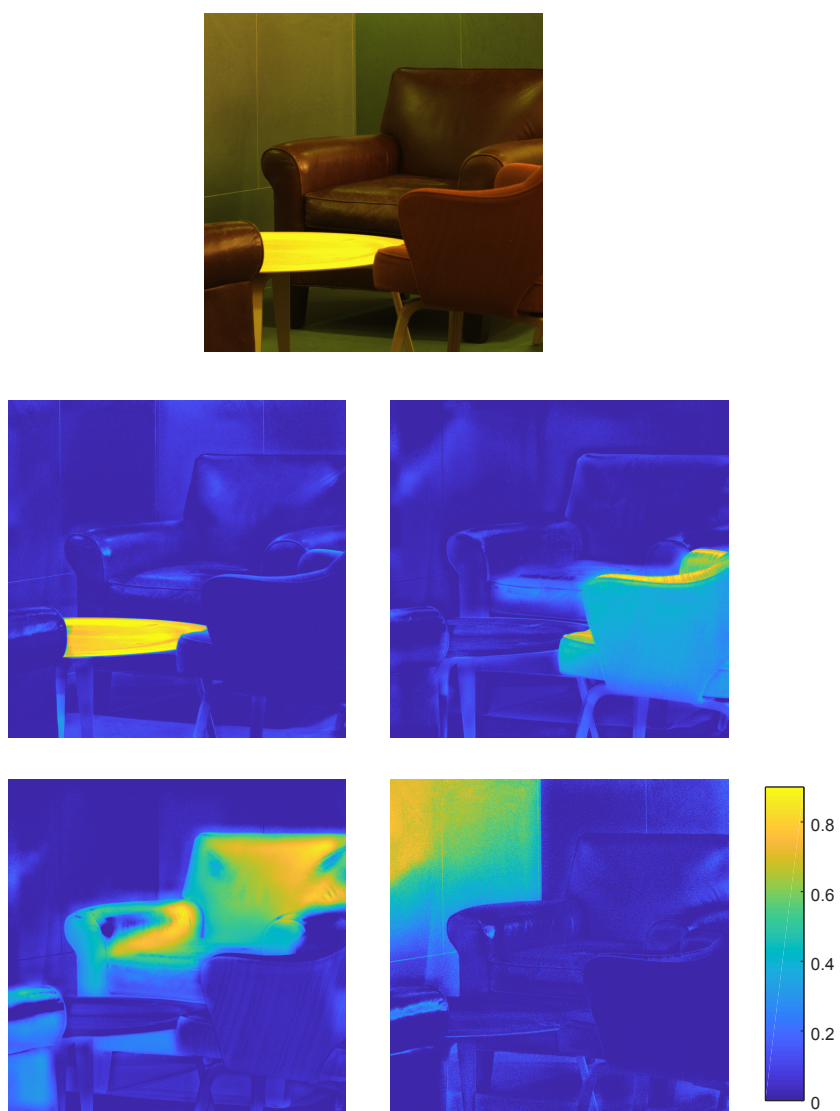
#	Image Name	<i>Bicubic</i>	<i>SNNMF</i>	<i>HySure</i>	<i>R-FUSE</i>	<i>CNMF</i>	<i>SupResPALM</i>
51	imge7	0.937	0.982	0.982	0.977	0.982	0.984
52	imgf1	0.842	0.905	0.912	0.932	0.909	0.934
53	imgf2	0.944	0.982	0.981	0.971	0.973	0.984
54	imgf3	0.943	0.975	0.970	0.953	0.965	0.981
55	imgf4	0.618	0.691	0.681	0.673	0.673	0.685
56	imgf5	0.986	0.996	0.996	0.993	0.993	0.993
57	imgf6	0.999	0.998	0.998	0.999	0.997	0.993
58	imgf7	0.910	0.976	0.974	0.951	0.964	0.977
59	imgf8	0.946	0.980	0.983	0.961	0.988	0.980
60	imgg0	0.992	0.993	0.993	0.994	0.993	0.994
61	imgg1	0.932	0.970	0.979	0.972	0.969	0.983
62	imgg2	0.999	0.994	1.000	0.999	1.000	1.000
63	imgg3	0.662	0.772	0.796	0.801	0.803	0.804
64	imgg4	0.978	0.989	0.994	0.991	0.987	0.994
65	imgg5	0.532	0.757	0.744	0.777	0.781	0.794
66	imgg6	0.694	0.774	0.752	0.758	0.768	0.774
67	imgg7	0.906	0.928	0.935	0.938	0.929	0.939
68	imgg8	0.921	0.950	0.946	0.941	0.951	0.952
69	imgg9	0.984	0.994	0.996	0.993	0.994	0.996
70	imgH0	0.607	0.841	0.832	0.844	0.836	0.853
71	imgH1	0.997	0.999	0.999	0.998	0.999	0.997
72	imgH2	0.967	0.981	0.982	0.943	0.979	0.981
73	imgH3	0.996	0.999	1.000	0.999	0.999	0.996
74	imgH4	0.961	0.970	0.974	0.975	0.973	0.975
75	imgH5	0.955	0.967	0.976	0.972	0.977	0.979
76	imgH6	0.818	0.876	0.876	0.878	0.869	0.884
77	imgH7	0.996	0.999	0.999	0.999	0.999	1.000
<i>Average</i>		<i>0.863</i>	<i>0.925</i>	<i>0.929</i>	<i>0.927</i>	<i>0.926</i>	<b><i>0.934</i></b>

**Table 13.** Effect of the sparsity parameter  $s$  for Harvard. The first row is the selected sparsity level (average number of non-zero endmembers per pixel). The values in the first column are without the additional sparsity term.

$s/N_m$	Harvard database					
	—	6	5	4	3	2
RMSE	1.81	2.01	2.08	2.19	2.50	3.39
ERGAS	0.318	0.351	0.363	0.378	0.416	0.498
SAM	3.16	3.36	3.44	3.58	3.88	4.29



**Figure 1.** *Top:* Example image from the CAVE database. *Middle and bottom:* Abundances capture differently coloured flowers.



**Figure 2.** *Top:* Example image from the Harvard database. *Middle and bottom:* Abundances capture different materials.