NTIRE 2017 Challenge on Single Image Super-Resolution: Dataset and Study (supplementary material)

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Abstract

This is a supplement to our paper, "NTIRE 2017 Challenge on Single Image Super-Resolution: Dataset and Study" [1]. We report results for the top challenge methods [10]: SNU_CVLab1 [6], SNU_CVLab2 [6], Lab402 [2] and HelloSR [10] in comparison with VDSR [5] and A+ [12]. We use the classic setup (bicubic downscaling) of the challenge and report PSNR, SSIM [9], IFC [8], and CORNIA [13] results computed on Y channel from YCbCr or directly on the RGB super-resolved image for $\times 2$, $\times 3$, $\times 4$ magnification factors. In addition to our newly introduced DIV2K dataset [1] we report also results for the most commonly used datasets in the recent literature: Set5 [3, 11], Set14 [14], B100 [7, 12], and Urban100 [4].

1. DIV2K Test 100 images: quantitative results

In Tables 1,2,and 3 we report average quantitative results over DIV2K test 100 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	36.38	0.953	8.11	13.4	34.93	0.948	8.22	13.0
SNU_CVLab2	36.28	0.953	8.06	14.7	34.83	0.947	8.17	14.4
Lab402	36.12	0.952	7.97	13.6	34.66	0.946	8.07	13.3
HelloSR	35.87	0.950	7.91	15.1	34.43	0.944	8.03	14.7
VDSR[5]	35.09	0.943	7.28	17.7	33.47	0.935	7.36	17.4
A+[12]	34.26	0.935	7.98	29.5	32.64	0.925	7.15	29.4
Bicubic	32.44	0.910	6.31	45.9	30.98	0.899	5.76	45.6

Table 1. Quantitative results on the test set of DIV2K with $\times 2$.

Method	com	puted on	YCbCr		compute			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	32.59	0.900	4.97	21.2	31.13	0.889	5.01	20.9
SNU_CVLab2	32.49	0.899	4.93	22.2	31.04	0.888	4.97	21.9
Lab402	32.29	0.896	4.80	22.8	30.83	0.884	4.83	22.5
HelloSR	32.20	0.895	4.78	23.4	30.74	0.883	4.82	23.1
VDSR[5]	31.48	0.881	4.40	27.0	29.89	0.866	4.43	26.9
A+[12]	30.89	0.869	4.61	40.3	29.32	0.852	4.26	40.3
Bicubic	29.66	0.837	3.67	58.3	28.20	0.821	3.43	57.9

Table 2. Quantitative results on the test set of DIV2K with $\times 3$.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	30.56	0.853	3.39	26.4	29.09	0.837	3.41	26.2
SNU_CVLab2	30.51	0.852	3.38	27.1	29.04	0.836	3.40	27.1
Lab402	30.30	0.846	3.28	28.9	28.83	0.830	3.30	28.8
HelloSR	30.27	0.846	3.26	28.2	28.80	0.830	3.28	28.1
VDSR[5]	29.58	0.828	2.91	35.2	27.98	0.808	2.93	35.3
A+[12]	29.15	0.815	3.05	46.3	27.58	0.793	2.86	46.5
Bicubic	28.12	0.782	2.39	65.5	26.64	0.760	2.27	65.3

Table 3. Quantitative results on the test set of DIV2K with $\times 4$.

2. DIV2K Validation 100 images: quantitative results

In Tables 4,5,and 6 we report average quantitative results over DIV2K test 100 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference. Our computed results follow the protocol from the NTIRE 2017 Challenge [10] and use the provided codes by the top contenders also the publicly released models for VDSR [5] and A+ [12]. SNU_CVLab1 and SNU_CVLab1 provide comparable performance on DIV2K test dataset, while the results for SNU_CVLab1 are significantly better than those for SNU_CVLab2 on DIV2K validation dataset. This is likely because SNU_CVLab1 used DIV2K validation images for model training.

Method	com	puted on	Y from	YCbCr		compute	d on Re	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	36.82	0.950	8.07	10.4	35.39	0.943	8.18	10.1
SNU_CVLab2	36.58	0.948	7.99	11.8	35.15	0.941	8.09	11.5
Lab402	36.32	0.946	7.88	11.1	34.89	0.939	7.97	10.8
HelloSR	36.11	0.946	7.84	12.3	34.71	0.938	7.95	11.9
VDSR[5]	35.27	0.938	7.23	14.6	33.70	0.929	7.30	14.5
A+[12]	34.40	0.929	7.80	26.6	32.82	0.918	7.06	26.5
Bicubic	32.40	0.903	6.14	44.0	30.98	0.891	5.65	43.7

Table 4. Quantitative results on the validation set of DIV2K with $\times 2$.

Method	com	puted on	Y from	YCbCr		compute	d on R	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	33.33	0.899	4.99	17.1	31.90	0.887	5.03	17.0
SNU_CVLab2	32.95	0.894	4.88	18.3	31.52	0.882	4.92	18.1
HelloSR	32.54	0.889	4.72	19.8	31.12	0.876	4.76	19.7
Lab402	32.54	0.889	4.72	19.5	31.10	0.876	4.75	19.5
VDSR[5]	31.70	0.875	4.32	24.0	30.14	0.859	4.35	23.9
A+[12]	31.03	0.862	4.48	38.0	29.50	0.844	4.17	38.2
Bicubic	29.62	0.829	3.55	56.4	28.20	0.811	3.34	56.1

Table 5. Quantitative results on the validation set of DIV2K with $\times 3$.

Method	com	puted on	YCbCr		compute	d on Ro	GB	
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	31.29	0.853	3.43	22.5	29.85	0.836	3.45	22.5
SNU_CVLab2	30.98	0.847	3.36	23.7	29.54	0.831	3.37	23.7
HelloSR	30.66	0.841	3.23	24.4	29.22	0.823	3.25	24.3
Lab402	30.56	0.839	3.23	25.6	29.12	0.822	3.24	25.7
VDSR[5]	29.78	0.822	2.85	32.5	28.21	0.800	2.87	32.5
A+[12]	29.26	0.807	2.95	45.1	27.74	0.784	2.79	45.2
Bicubic	28.08	0.773	2.30	64.6	26.65	0.750	2.19	64.4

Table 6. Quantitative results on the validation set of DIV2K with $\times 4$.

3. Set5 images: quantitative results

In Tables 7,8,and 9 we report average quantitative results over Set5 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	38.18	0.961	8.33	17.6	36.06	0.946	8.43	17.2
SNU_CVLab2	38.12	0.961	8.29	17.4	35.99	0.945	8.40	17.1
Lab402	37.97	0.960	8.18	17.8	35.86	0.944	8.28	17.6
HelloSR	37.82	0.960	8.14	18.1	35.72	0.944	8.25	17.6
VDSR[5]	37.46	0.958	7.77	17.9	35.14	0.941	7.85	17.7
A+[12]	36.55	0.954	8.25	26.6	34.28	0.934	7.54	27.1
Bicubic	33.64	0.930	5.94	42.3	31.74	0.908	5.61	42.4

Table 7. Quantitative results on Set5 with $\times 2$.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	34.80	0.930	5.48	19.7	32.82	0.908	5.51	19.7
SNU_CVLab2	34.73	0.929	5.44	21.1	32.75	0.907	5.48	20.6
Lab402	34.46	0.927	5.27	20.0	32.48	0.904	5.30	19.6
HelloSR	34.46	0.928	5.30	20.9	32.46	0.903	5.32	20.6
VDSR[5]	33.69	0.922	4.92	18.0	31.54	0.895	4.94	17.8
A+[12]	32.70	0.910	4.85	32.6	30.63	0.881	4.63	33.2
Bicubic	30.41	0.869	3.51	54.1	28.63	0.838	3.41	54.1

Table 8. Quantitative results on Set5 with $\times 3$.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	32.64	0.901	3.88	23.7	30.73	0.873	3.89	23.7
SNU_CVLab2	32.61	0.900	3.88	25.1	30.71	0.872	3.89	24.9
HelloSR	32.35	0.898	3.76	23.6	30.43	0.868	3.76	23.4
Lab402	32.27	0.897	3.74	26.5	30.36	0.867	3.75	26.5
VDSR[5]	31.42	0.885	3.39	23.0	29.33	0.851	3.40	23.1
A+[12]	30.35	0.863	3.18	39.9	28.37	0.826	3.09	39.8
Bicubic	28.42	0.812	2.29	61.3	26.69	0.774	2.24	61.2

Table 9. Quantitative results on Set5 with $\times 4$.

4. Set14 images: quantitative results

In Tables 10,11,and 12 we report average quantitative results over Set5 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	34.14	0.920	8.18	11.2	32.09	0.898	8.28	11.1
SNU_CVLab2	34.01	0.920	8.12	12.2	31.97	0.898	8.21	12.0
Lab402	33.95	0.919	8.01	10.9	31.90	0.897	8.10	10.7
HelloSR	33.70	0.918	8.00	12.7	31.68	0.895	8.09	12.7
VDSR[5]	33.17	0.912	7.55	14.9	31.00	0.885	7.61	14.7
A+[12]	32.43	0.904	7.89	25.7	30.34	0.876	7.43	25.8
Bicubic	30.33	0.869	5.96	42.4	28.52	0.842	5.71	42.4

Table 10. Quantitative results on Set14 with $\times 2$.

Method	com	puted on	Y from	YCbCr		compute	d on R	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	30.73	0.848	5.00	18.3	28.87	0.817	5.02	18.3
SNU_CVLab2	30.63	0.846	4.95	17.8	28.76	0.816	4.98	17.8
Lab402	30.49	0.843	4.82	18.7	28.63	0.812	4.84	18.8
HelloSR	30.45	0.843	4.83	18.3	28.58	0.812	4.86	18.4
VDSR[5]	29.89	0.832	4.45	21.1	27.90	0.794	4.47	21.2
A+[12]	29.28	0.820	4.47	34.4	27.36	0.783	4.30	34.4
Bicubic	27.63	0.775	3.43	56.7	25.94	0.739	3.33	56.5

Table 11. Quantitative results on Set14 with $\times 3$.

Method	com	puted on	Y from	YCbCr		compute	d on Ro	GB
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	28.94	0.788	3.42	22.7	27.15	0.753	3.43	22.8
SNU_CVLab2	28.88	0.787	3.40	23.4	27.09	0.751	3.41	23.4
Lab402	28.73	0.783	3.32	25.4	26.94	0.747	3.33	25.4
HelloSR	28.72	0.783	3.31	24.4	26.93	0.747	3.32	24.5
VDSR[5]	28.11	0.768	2.97	26.8	26.20	0.724	2.99	26.8
A+[12]	27.43	0.751	2.92	40.6	25.62	0.708	2.84	40.7
Bicubic	26.08	0.703	2.22	63.6	24.46	0.662	2.18	63.4

Table 12. Quantitative results on Set14 with $\times 4$.

5. B100 images: quantitative results

In Tables 13,14,and 15 we report average quantitative results over Set5 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	32.33	0.902	7.29	14.3	30.95	0.893	7.36	14.2
SNU_CVLab2	32.28	0.901	7.26	15.8	30.90	0.892	7.33	15.7
Lab402	32.18	0.900	7.21	14.8	30.80	0.891	7.27	14.6
HelloSR	32.09	0.899	7.17	15.7	30.71	0.890	7.25	15.5
VDSR[5]	31.81	0.895	6.90	16.4	30.41	0.885	6.95	16.3
A+[12]	31.13	0.884	7.19	29.0	29.71	0.872	6.65	29.0
Bicubic	29.48	0.843	5.53	47.7	28.12	0.828	5.21	47.5

Table 13. Quantitative results on B100 with $\times 2$.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	29.28	0.811	4.23	23.8	27.90	0.793	4.24	23.8
SNU_CVLab2	29.23	0.810	4.20	25.1	27.85	0.791	4.22	25.2
Lab402	29.10	0.807	4.15	25.6	27.71	0.788	4.17	25.6
HelloSR	29.07	0.806	4.12	25.2	27.68	0.787	4.13	25.2
VDSR[5]	28.74	0.797	3.92	27.1	27.32	0.777	3.93	27.2
A+[12]	28.23	0.783	3.95	39.6	26.82	0.761	3.75	39.7
Bicubic	27.12	0.738	3.10	60.3	25.76	0.713	2.98	60.0

Table 14. Quantitative results on $\overset{\ }{B}$ 100 with $\times 3$.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	27.74	0.744	2.79	29.1	26.36	0.719	2.80	29.5
SNU_CVLab2	27.72	0.743	2.79	29.7	26.34	0.718	2.80	30.0
Lab402	27.59	0.738	2.76	31.1	26.21	0.712	2.77	31.3
HelloSR	27.58	0.738	2.73	30.7	26.20	0.712	2.73	30.9
VDSR[5]	27.20	0.724	2.54	34.3	25.78	0.697	2.55	34.6
A+[12]	26.74	0.709	2.51	46.7	25.33	0.680	2.41	46.7
Bicubic	25.87	0.666	1.95	67.6	24.50	0.636	1.89	67.3

Table 15. Quantitative results on B100 with $\times 4$.

6. Urban100 images: quantitative results

In Tables 16,17,and 18 we report average quantitative results over Set5 images for magnification factors $\times 2$, $\times 3$, and $\times 4$, respectively. Bicubic interpolation result is included for reference.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	33.21	0.937	9.38	-2.3	31.58	0.929	9.50	-2.6
SNU_CVLab2	33.09	0.936	9.27	-0.9	31.45	0.928	9.38	-1.2
Lab402	32.62	0.932	9.06	-2.1	31.00	0.924	9.16	-2.4
HelloSR	32.30	0.929	9.01	-0.1	30.70	0.920	9.13	-0.3
VDSR[5]	30.73	0.913	8.01	3.2	29.05	0.901	8.08	2.9
A+[12]	29.18	0.892	8.19	17.9	27.60	0.879	7.62	17.7
Bicubic	26.85	0.839	6.16	40.5	25.41	0.826	5.80	40.0

Table 16. Quantitative results on Urban 100 with $\times 2$.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	29.08	0.870	6.08	5.4	27.52	0.855	6.12	5.3
SNU_CVLab2	28.98	0.868	5.99	5.9	27.42	0.853	6.03	5.8
Lab402	28.46	0.858	5.71	7.3	26.91	0.842	5.74	7.3
HelloSR	28.37	0.856	5.71	7.7	26.83	0.840	5.75	7.6
VDSR[5]	27.10	0.826	4.91	12.6	25.49	0.807	4.93	12.5
A+[12]	26.02	0.796	4.80	30.7	24.49	0.776	4.58	30.5
Bicubic	24.43	0.733	3.59	54.4	22.99	0.712	3.45	53.8

Table 17. Quantitative results on Urban 100 with $\times 3$.

Method	computed on Y from YCbCr				computed on RGB			
	PSNR	SSIM	IFC	CORNIA	PSNR	SSIM	IFC	CORNIA
SNU_CVLab1	26.88	0.808	4.31	10.7	25.36	0.789	4.32	10.7
SNU_CVLab2	26.83	0.807	4.26	10.9	25.30	0.787	4.28	11.0
Lab402	26.37	0.792	4.04	13.1	24.86	0.772	4.06	13.1
HelloSR	26.32	0.792	4.01	13.4	24.82	0.771	4.03	13.4
VDSR[5]	25.13	0.750	3.32	21.5	23.57	0.725	3.33	21.6
A+[12]	24.31	0.718	3.17	39.5	22.81	0.692	3.06	39.3
Bicubic	23.11	0.656	2.35	63.4	21.67	0.629	2.28	63.0

Table 18. Quantitative results on Urban100 with $\times 4$.

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