Recurrent Back-Projection Network For Video Super-Resolution

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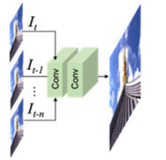
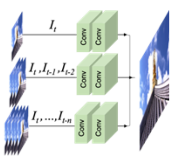
Existing Networks

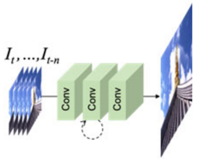
(a) Temporal Concatenation



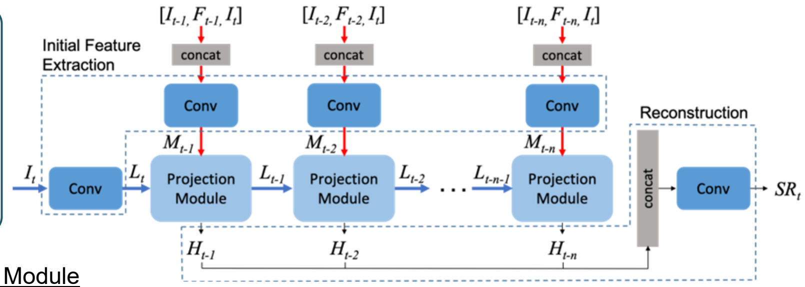
(b) Temporal Aggregation



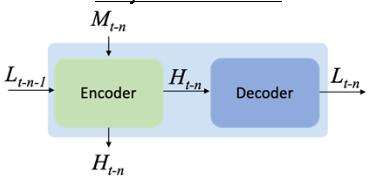
(c) Recurrent NNs



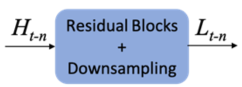
Our Proposed Network



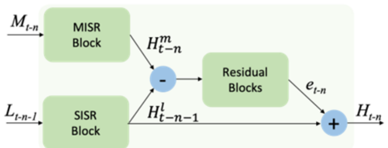
Projection Module



Decoder



Encoder



Our Contributions

(1) Integrating SISR and MISR in a unified VSR framework

SISR and MISR extract missing details from different sources, then iteratively updated in temporal order

(2) Back-projection modules for RBPN

The network treats each context as different cues which allows RBPN to separately capture the degree of change for each context.

Ablation Studies

Baseline comparison on SPMCS-32

Bicubic 1 Frame	DBPN 1 Frame	DBPN-MISR 5 Frames	RBPN-MISR 5 Frames	RBPN 5 Frames
27.13/0.749	29.85/0.837	30.64/0.859	30.89/0.866	31.40/0.877

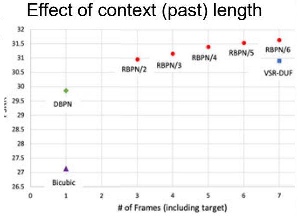
Effect of temporal order of context, RBPN/6 on SPMCS-32

	P	PR	P → PR	PR → P
PSNR/SSIM	31.40/0.877	31.39/0.876	31.39/0.877	31.35/0.875

Effect of temporal order, RBPN/4 on SPMCS-32

	P	PF	P → PF	PF → P
PSNR/SSIM	31.64/0.883	31.74/0.884	31.66/0.884	31.57/0.881

Effect of context (past) length



Experimental Results

Qualitative evaluation on Vid4 for 4x

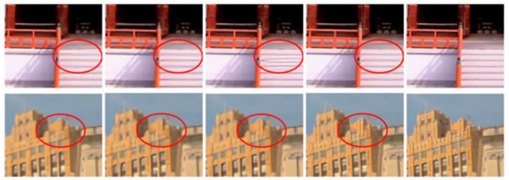
Clip Name	Flow Magnitude	Bicubic	DBPN [8]	BRCN [13]	VESPCN [2]	$B_{123}+T$ [25]	DRDVSR [30]	FRVSR [27]	VSR-DUF [16]	RBPN/6-PF
Calendar	1.14	19.82/0.554	22.19/0.714	-	-	21.66/0.704	22.18/0.746	-	(24.09/0.813*)	23.99/0.807 (23.93/0.803*)
City	1.63	24.93/0.586	26.01/0.684	-	-	26.45/0.720	26.98/0.755	-	(28.26/0.833*)	27.73/0.803 (27.64/0.802*)
Foliage	1.48	23.42/0.575	24.67/0.662	-	-	24.98/0.698	25.42/0.720	-	(26.38/0.771*)	26.22/0.757 (26.27/0.757*)
Walk	1.44	26.03/0.802	28.61/0.870	-	-	28.26/0.859	28.92/0.875	-	(30.50/0.912*)	30.70/0.909 (30.65/0.911*)
Average	1.42	23.53/0.629	25.37/0.737	24.43/0.662	25.35/0.756	25.34/0.745	25.88/0.774	26.69/0.822	(27.31/0.832*)	27.12/0.818 (27.16/0.819*)

Qualitative evaluation on SPMCS-11 for 4x

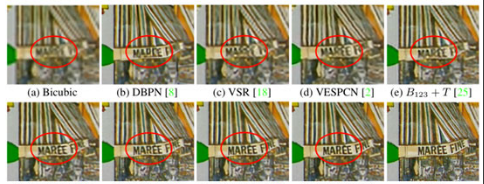
Clip Name	Flow Magnitude	Bicubic	DBPN [8] (1 Frame)	DRDVSR [30] (7 Frames)	VSR-DUF [16] (7 Frames)	RBPN/4-P (5 Frames)	RBPN/6-P (7 Frames)	RBPN/6-PF (7 Frames)
car05_001	6.21	27.62	29.58	32.07	30.77	31.51	31.65	31.92
hdclub_003_001	0.70	19.38	20.22	21.03	22.07	21.62	21.91	21.88
hitachi_isee5_001	3.01	19.59	23.47	23.83	25.73	25.80	26.14	26.40
hk004_001	0.49	28.46	31.59	32.14	32.96	32.99	33.25	33.31
HKVTG_004	0.11	27.37	28.67	28.71	29.15	29.28	29.39	29.43
jvc_009_001	1.24	25.31	27.89	28.15	29.26	29.81	30.17	30.26
NYVTG_006	0.10	28.46	30.13	31.46	32.29	32.83	33.09	33.25
PRVTG_012	0.12	25.54	26.36	26.95	27.47	27.33	27.52	27.60
RMVTG_011	0.18	24.00	25.77	26.49	27.63	27.33	27.64	27.69
veni3_011	0.36	29.32	34.54	34.66	34.51	36.28	36.14	36.53
veni5_015	0.36	27.30	30.89	31.51	31.75	32.45	32.66	32.82
Average	1.17	25.67/0.726	28.10/0.820	28.82/0.841	29.42/0.867	29.75/0.866	29.96/0.873	30.10/0.874

Qualitative evaluation on Vimeo90K for 4x

Algorithm	Vimeo-90k Slow	Medium	Fast
Bicubic	29.33/0.829	31.28/0.867	34.05/0.902
DBPN [8]	32.98/0.901	35.39/0.925	37.46/0.944
TOFLOW [34]	32.16/0.889	35.02/0.925	37.64/0.942
VSR-DUF/6 [16]	32.96/0.909	35.84/0.943	37.49/0.949
RBPN/3-P	33.73/0.914	36.66/0.941	39.49/0.955
RBPN/6-PF	34.18/0.920	37.28/0.947	40.03/0.960
# of clips	1,616	4,983	1,225
Avg. Flow Mag.	0.6	2.5	8.3



(a) DBPN [8] (b) DRDVSR [30] (c) VSR-DUF [16] (d) RBPN/6-PF (e) GT



(a) Bicubic (b) DBPN [8] (c) VSR [18] (d) VESPCN [2] (e) $B_{123}+T$ [25]

(f) DRDVSR [30] (g) FRVSR [27] (h) VSR-DUF [16] (i) RBPN/6-PF (j) GT

(a) Bicubic (b) TOFlow [34] (c) VSR-DUF [16] (d) RBPN/3-P (e) RBPN/6-PF (f) GT

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