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BALF
Simple and Efficient Blur Aware Local Feature Detector

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Paper, code, and video are available at:
ericzzj1989.github.io/balf

Problem and Contribution

Goal: Detect salient and repeatable local features in blurred images.

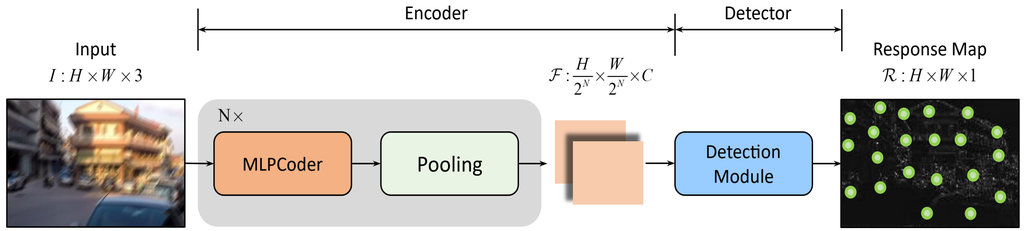
Contributions:

- Propose a novel and efficient **MLP-based network architecture** for local feature detection, which has **never been attempted** for this task previously.
- Extensive experimental results demonstrate that our network achieves **superior detection performance** over prior works on motion blurred images, while **keeping comparable performance** for sharp images.
- Our motion blur robust keypoint detector is able to run in **real-time**, which would enable many time-constrained applications (*e.g.* robotic navigation in low-lighting scenarios).

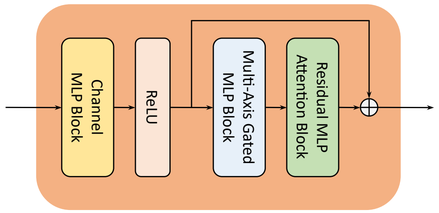
Method

BALF Framework:

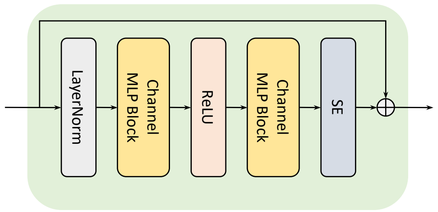
- **Pure MLP-based** network
- **MLP-based encoder** and **MLP-based detection module**



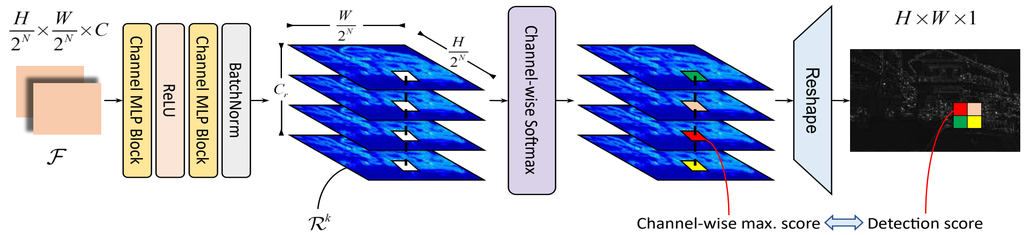
MLPCoder Block:



Residual MLP Attention Block (RMAB):

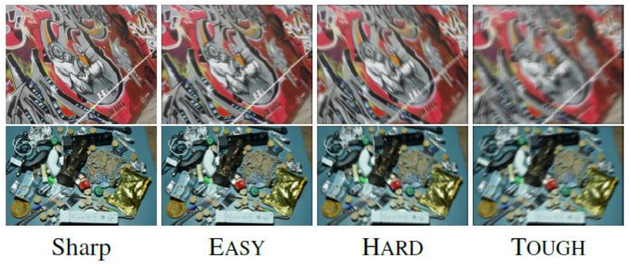


MLP-Based Detection Module:



Experiments and Results

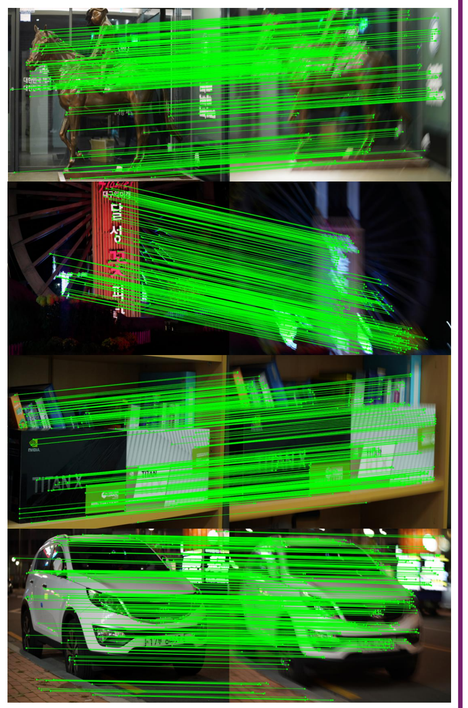
Synthetic Motion Blurred Image Dataset: Blur-Hpatches



Efficiency Results:

Method	240×320 pixels ↓	480×640 pixels ↓
SIFT [34]	21.80	66.70
SURF [6]	148.46	165.78
Harris-LapLace [38]	110.41	377.13
Shi-Tomasi [56]	5.20	21.69
MSER [36]	64.19	221.79
KAZE [2]	105.85	298.43
AKZE [3]	18.02	56.93
FAST [47]	0.89	1.88
LIFT [74]	2209.03	4901.38
Key.Net [25]	15.64	35.82
SuperPoint [12]	2.41	3.98
LF-Net [41]	282.77	855.77
BALF (ours)	8.15	29.02

Qualitative Results on RealBlur Dataset:



Evaluation on HPatches Dataset:

Method	Reference: Sharp Target: Sharp		
	Viewpoint ↑	Illumination ↑	Total ↑
SIFT [34]	60.29	60.44	60.36
SURF [6]	62.67	64.01	63.33
Harris-Laplace [38]	63.89	62.91	63.41
Shi-Tomasi [56]	69.28	64.13	66.74
MSER [36]	52.45	50.58	51.53
KAZE [2]	67.30	65.67	66.50
AKAZE [3]	66.08	69.07	67.55
FAST [47]	66.08	63.65	64.88
LIFT [74]	56.97	60.73	58.82
Key.Net [25]	68.99	67.47	68.24
SuperPoint [12]	**69.53**	68.92	69.23
LF-Net [41]	68.41	**73.61**	**70.96**
D2-Net [14]	53.99	62.80	58.32
R2D2 [44]	61.68	61.93	61.80
BALF (ours)	67.21	73.51	70.28

Evaluation on Blur-HPatches Dataset:

Method	Reference: Sharp Target: Blur			Reference: Blur Target: Blur		
	EASY ↑	HARD ↑	TOUGH ↑	EASY ↑	HARD ↑	TOUGH ↑
SIFT [34]	55.92	56.80	53.49	56.99	53.49	45.94
SURF [6]	58.88	56.23	56.24	61.08	58.04	53.60
Harris-Laplace [38]	36.70	37.97	34.98	35.76	31.95	27.47
Shi-Tomasi [56]	57.33	55.11	49.11	56.29	53.75	51.37
MSER [36]	44.19	41.97	37.05	41.81	38.24	34.59
KAZE [2]	49.90	46.84	39.98	63.29	58.71	46.90
AKAZE [3]	54.15	50.51	45.49	65.16	62.20	51.54
FAST [47]	61.98	61.77	51.37	57.84	53.35	51.17
LIFT [74]	50.69	50.17	46.99	48.34	46.57	46.53
Key.Net [25]	60.34	54.71	44.69	62.77	58.17	49.25
SuperPoint [12]	65.64	62.22	52.84	58.60	50.03	43.28
LF-Net [41]	63.54	61.19	56.78	60.45	59.07	57.71
D2-Net [14]	49.71	47.30	44.32	51.80	51.05	50.53
R2D2 [44]	57.99	51.73	40.57	57.49	55.31	46.86
BALF (ours)	**74.12**	**74.45**	**71.84**	**70.48**	**68.43**	**67.71**

Evaluation on Blur-HPatches Dataset Preprocessed by Deblurring Network:

Method	Reference: Sharp Target: Deblur						Reference: Deblur Target: Deblur					
	SRN-DeblurNet [60]			DeblurGAN-v2 [24]			SRN-DeblurNet [60]			DeblurGAN-v2 [24]		
	EASY ↑	HARD ↑	TOUGH ↑	EASY ↑	HARD ↑	TOUGH ↑	EASY ↑	HARD ↑	TOUGH ↑	EASY ↑	HARD ↑	TOUGH ↑
SIFT [34]	56.62	55.36	53.83	57.63	56.52	56.50	59.75	58.13	50.63	59.44	57.98	51.21
SURF [6]	61.89	59.13	54.88	61.97	59.57	56.34	62.44	61.26	55.27	62.07	60.81	55.09
Harris-Laplace [38]	17.15	16.87	20.54	16.60	16.90	20.24	36.98	35.73	32.23	37.09	35.97	31.54
Shi-Tomasi [56]	60.56	56.87	48.78	61.75	59.10	51.56	63.18	61.03	50.88	63.58	61.89	53.76
MSER [36]	46.65	43.23	37.90	47.62	45.14	40.70	47.70	45.40	37.49	47.84	45.56	38.01
KAZE [2]	65.14	63.10	60.16	65.23	63.18	61.41	64.20	62.45	53.41	64.13	61.87	54.19
AKAZE [3]	66.03	64.02	60.64	66.29	64.50	62.72	65.71	64.08	56.10	65.75	63.75	57.35
FAST [47]	61.77	59.67	61.60	62.00	60.44	58.74	62.72	61.14	50.61	63.40	61.70	55.43
LIFT [74]	54.98	52.64	46.75	56.59	53.54	49.09	55.88	53.64	45.31	56.68	55.31	50.44
Key.Net [25]	63.28	58.01	47.10	63.99	59.16	49.35	62.86	60.44	50.74	62.73	60.58	52.96
SuperPoint [12]	67.72	64.05	55.26	67.95	65.86	58.22	66.38	63.16	49.52	66.50	63.71	52.09
LF-Net [41]	62.22	59.90	54.73	62.59	60.24	54.81	63.06	62.03	57.28	63.00	61.79	57.85
D2-Net [14]	51.81	49.49	45.94	52.64	50.21	45.88	53.60	53.00	50.93	53.93	53.29	50.74
R2D2 [44]	60.31	55.43	43.26	60.46	55.68	45.38	58.11	54.80	45.77	57.95	55.03	47.86
BALF (ours)	**74.12 / 74.45 / 71.84** (EASY / HARD / TOUGH)						**70.48 / 68.43 / 67.71** (EASY / HARD / TOUGH)					

Evaluation on GoPro Dataset:

Method	Reference: Sharp Target: Blur ↑	Reference: Blur Target: Blur ↑
SIFT [34]	60.53	60.03
SURF [6]	56.49	60.03
Harris-Laplace [38]	23.54	16.35
Shi-Tomasi [56]	51.26	57.61
MSER [36]	46.54	43.09
KAZE [2]	49.35	48.86
AKAZE [3]	56.34	50.51
FAST [47]	51.20	45.04
LIFT [74]	48.61	50.56
Key.Net [25]	57.54	58.37
SuperPoint [12]	53.83	51.38
LF-Net [41]	60.82	66.60
D2-Net [14]	53.37	56.96
R2D2 [44]	50.34	53.94
BALF (ours)	**75.68**	**75.15**