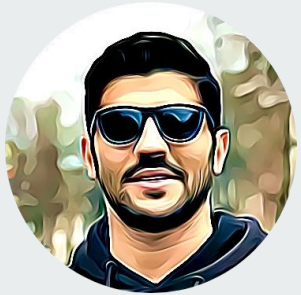
LiNet: A Lightweight Network for Single Image Super Resolution



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Outline

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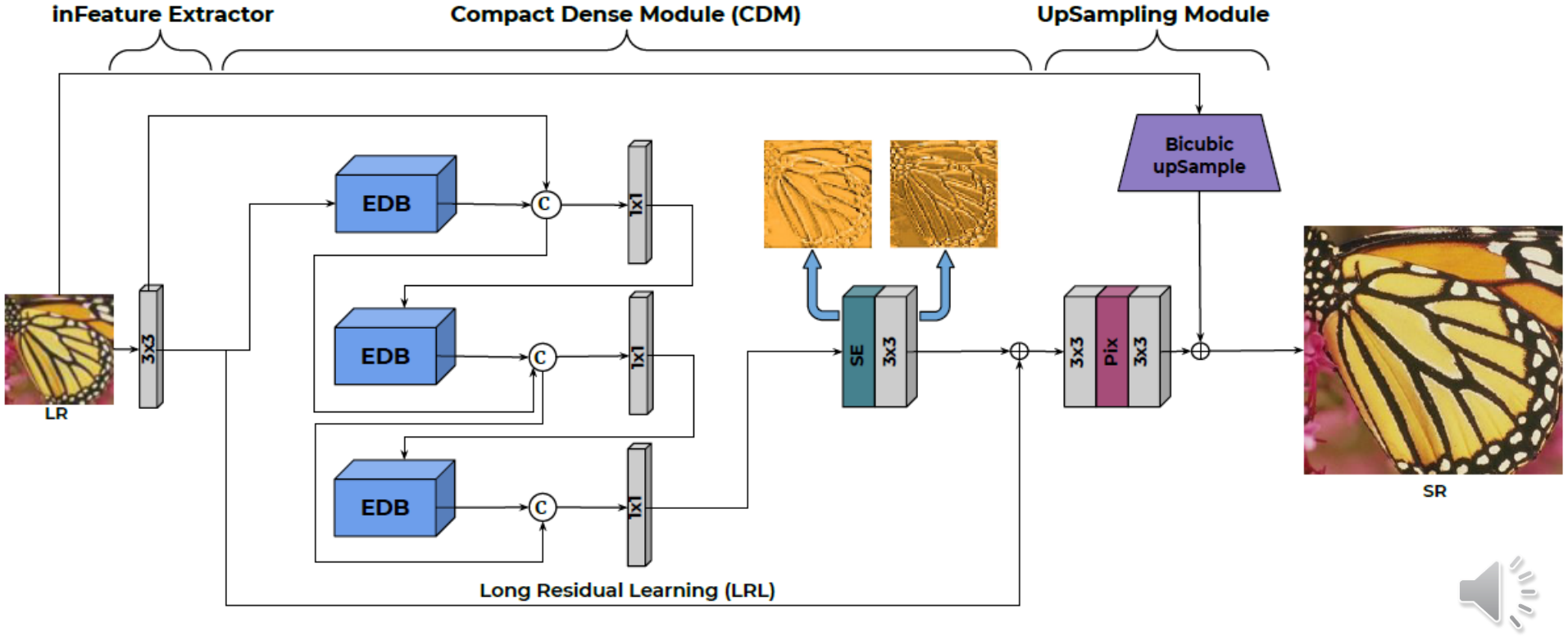
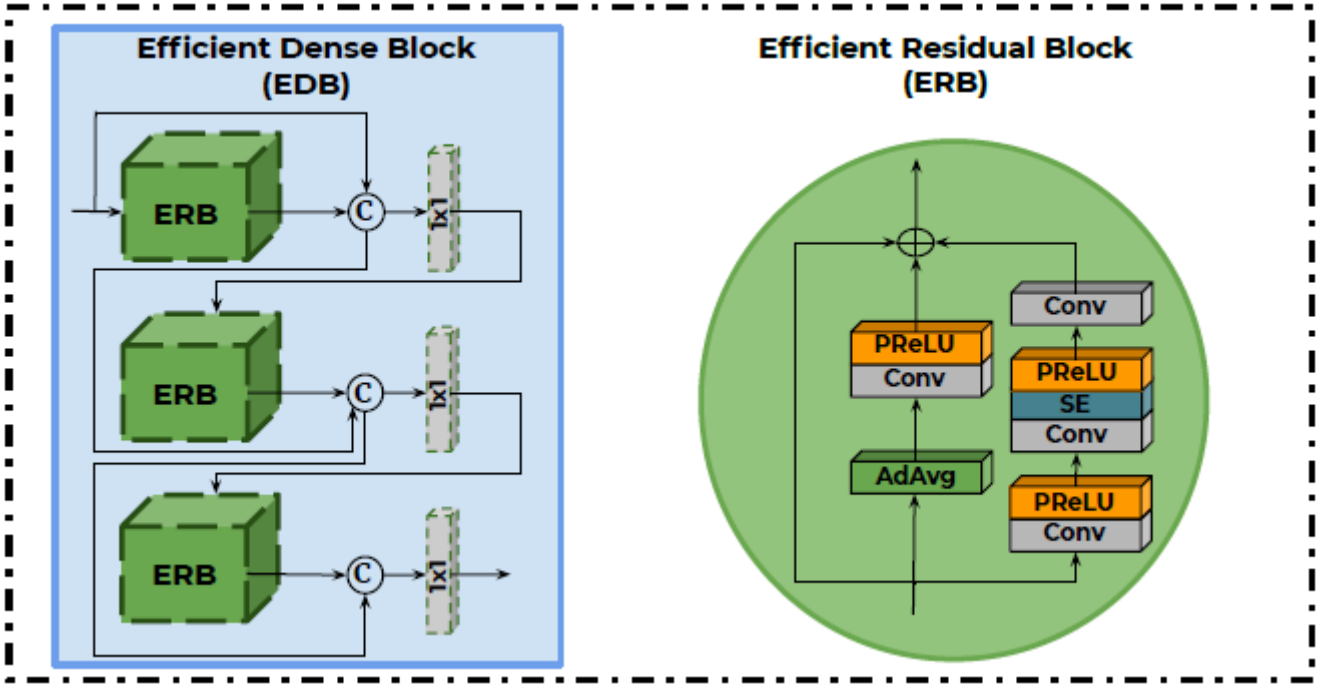
Introduction & Motivation

- **Super Resolution** is the process of recovering a **High Resolution (HR)** image from a given **Low Resolution (LR)** image
- Super Resolution is an **ill-posed** inverse problem
- By increasing the **scale factor**, difficulty of the problem **increases**
- Most of the approaches achieved high performance by sacrificing **memory** and **computational cost**
- A lightweight network, with a performance roughly to heavy and deep methods, is needed for on-the-edge technology

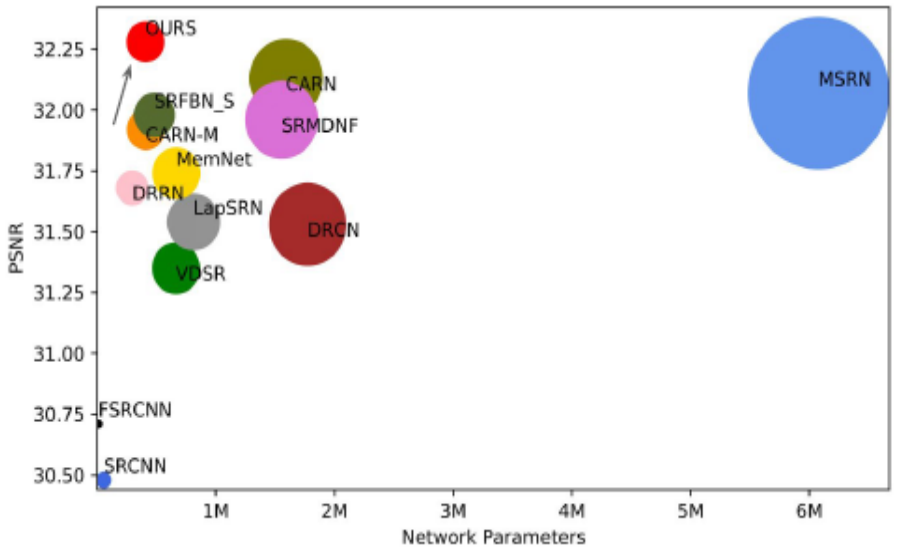
Proposed Network Architecture

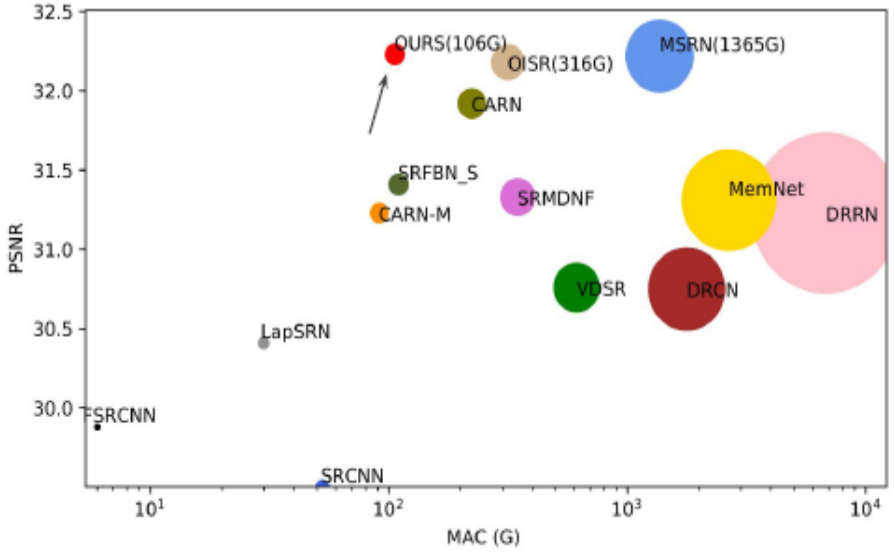


EDB and ERB


Efficient Dense Block
(EDB)
ERB
C
1x1
ERB
C
1x1
ERB
C
1x1
Efficient Residual Block
(ERB)
PReLU
Conv
AdAvg
Conv
PReLU
SE
Conv
PReLU
Conv

Performance Vs. Model Size and Mac



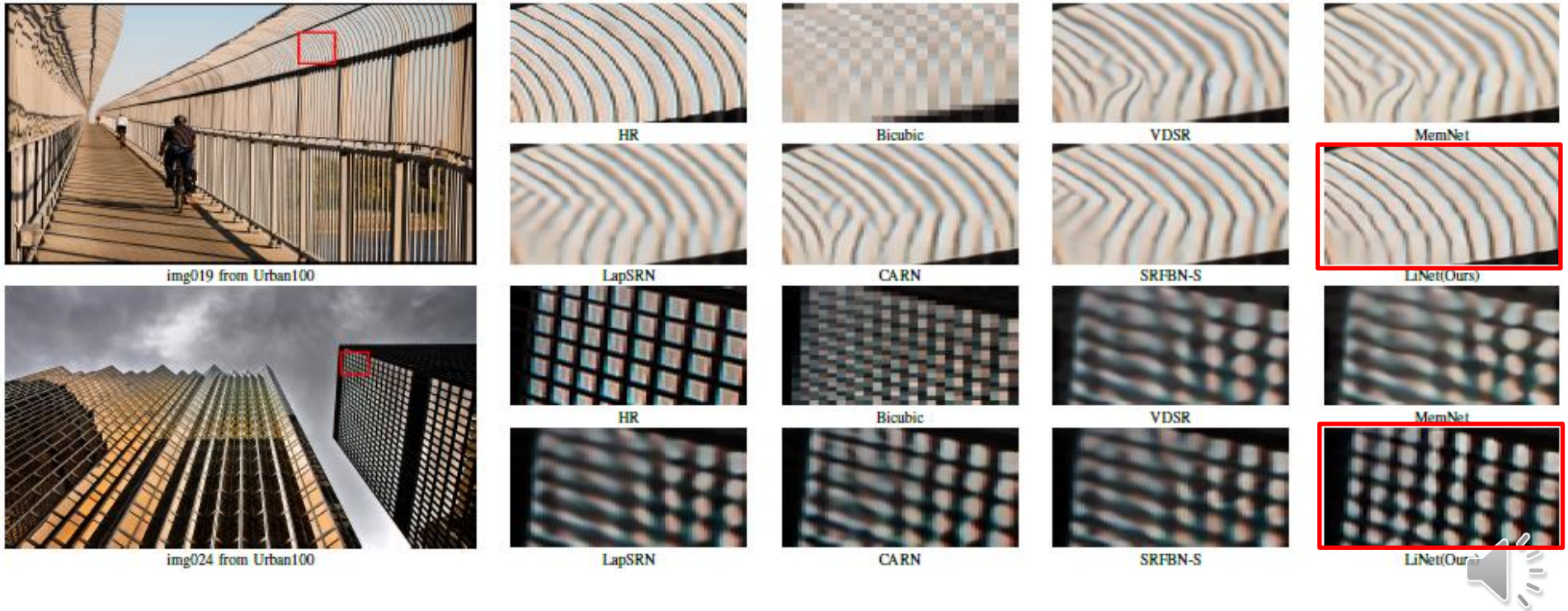


Experimental Results

Model	Scale	Params	Flops	Set5	Set14	B100	Urban100
SRCNN	×2	57K	52.7G	36.66/0.9542	32.42/0.9063	31.36/0.8879	29.50/0.8946
	×3			32.75/0.9090	29.28/0.8209	28.41/0.7863	26.24/0.7989
	×4			30.48/0.8628	27.49/0.7503	26.90/0.7101	24.52/0.7221
FSRCNN	×2	12K	6.0G	37.00/0.9558	32.63/0.9088	31.53/0.8920	29.88/0.9020
	×3			33.16/0.9140	29.43/0.8242	28.53/0.7910	26.43/0.8080
	×4			30.71/0.8657	27.59/0.7535	26.98/0.7150	24.62/0.7280
VDSR	×2	665K	612.6G	37.53/0.9587	33.03/09124	31.90/0.8960	30.76/0.9140
	×3			33.66/0.9213	29.77/0.8314	28.82/0.7976	27.14/0.8279
	×4			31.35/0.8838	28.01/0.7674	27.29/0.7251	25.18/0.7524
LapSRN	×2	813K	29.9G	37.52/0.9590	33.08/0.9130	31.80/0.8950	30.41/0.9100
	×4		149.4G	31.54/0.8850	28.19/0.7720	27.32/0.7280	25.21/0.7560
DRRN	×2	297K	6796.6G	37.74/0.9591	33.23/0.9136	32.05/0.8973	31.23/0.9188
	×3			34.03/0.9244	29.96/0.8349	28.95/0.8004	27.53/0.8378
	×4			31.68/0.8888	28.21/0.7720	27.38/0.7284	25.44/0.7638
MemNet	×2	667K	2662.4G	37.78/0.9597	33.28/0.9142	32.08/0.8978	31.31/0.9195
	×3			34.09/0.9248	30.00/0.8350	28.96/0.8001	27.56/0.8376
	×4			31.74/0.8893	28.26/0.7723	27.40/0.7281	25.50/0.7630
CARN-M	×2	412K	91.2G	37.53/0.9583	33.26/0.9141	31.92/0.8960	31.23/0.9193
	×4		46.1G	33.99/0.9236	30.08/0.8367	28.91/0.8000	27.55/0.8385
	×4		32.5G	31.92/0.8903	28.42/0.7762	27.44/0.7304	25.62/0.7694
SRFBN-S	×2	483K	119G	37.78/0.9597	33.35/0.9156	32.00/0.8970	31.41/0.9207
	×3			34.20/0.9255	30.10/0.8350	28.96/0.8010	27.66/0.8415
	×4			31.98/0.9594	28.45/0.7779	27.44/0.7313	25.71/0.7719
DRCN	×2	1774K	222.8G	37.63/0.9588	33.04/0.9118	31.85/0.8942	30.75/0.9133
	×3		118.8G	33.82/0.9226	29.76/0.8311	28.80/0.7963	27.15/0.8276
	×4		90.9G	31.53/0.8854	28.02/0.7670	27.23/0.7233	25.14/0.7510
CARN	×2	1592K	222.8G	37.76/0.9590	33.52/0.9166	32.09/0.8978	31.92/0.9256
	×3		118.8G	34.29/0.9255	30.29/0.8407	29.06/0.8434	28.06/0.8493
	×4		90.9G	32.13/0.8937	28.60/0.7806	27.58/0.7349	26.07/0.7837
SRMDNF	×2	1513K	347.7G	37.79/0.9600	33.32/0.9150	32.05/0.8980	31.33/0.9200
	×3	1530K	156.3G	34.12/0.9250	30.04/0.8370	28.97/0.8030	27.57/0.8400
	×4	1555K	89.3G	31.96/0.8930	28.35/0.7770	27.49/0.7340	25.68/0.7730
OISR-RK-S	×2	1370K	316.2G	37.98/0.9604	33.58/0.9172	32.18/0.8996	32.21/0.9290
	×3	1370K	160.1G	34.39/0.9273	30.33/**0.8420**	29.10/0.8083	28.03/0.8544
	×4	1520K	114.2G	32.21/0.8950	**28.63/0.7822**	27.58/0.7364	26.14/0.7888
MSRN	×2	5930K	1365.4G	**38.08**/0.9605	**33.74**/0.9170	**32.23**/0.9013	**32.22**/0.9326
	×3	6008K	621.2G	34.38/0.9262	**30.34**/0.8395	29.08/0.8041	**28.08/0.8554**
	×4	6078K	349.8G	32.07/0.8903	28.60/0.7751	27.52/0.7273	26.04/0.7896
LiNet [Ours]	×2	509K	106.0G	38.03/**0.9610**	33.63/**0.9176**	32.22/**0.9099**	32.19/**0.9330**
	×3		66.2G	**34.40/0.9285**	30.33/0.8419	**29.13/0.8175**	28.07/0.8534
	×4		35.0G	**32.28/0.9034**	28.62/0.7810	**27.60/0.7373**	**26.15/0.7956**

TABLE I: Comparison with light computational methods on scale factors [×2, ×3, ×4]. Best results are **highlighted** and second best results are underlined.

Qualitative Results on BI



Conclusion

- A lightweight network with the best performance on the **SOTA** has been presented
- ***Compact Dense Module*** is proposed by focusing on intermediate and high level information
- An ***Efficient Residual Block*** is proposed, which extract the information via multi-learning pathway
- Extensive evaluations and comparisons on benchmark datasets well demonstrate the effectiveness of our LiNet