Image Super-Resolution Using Deep Convolutional Networks

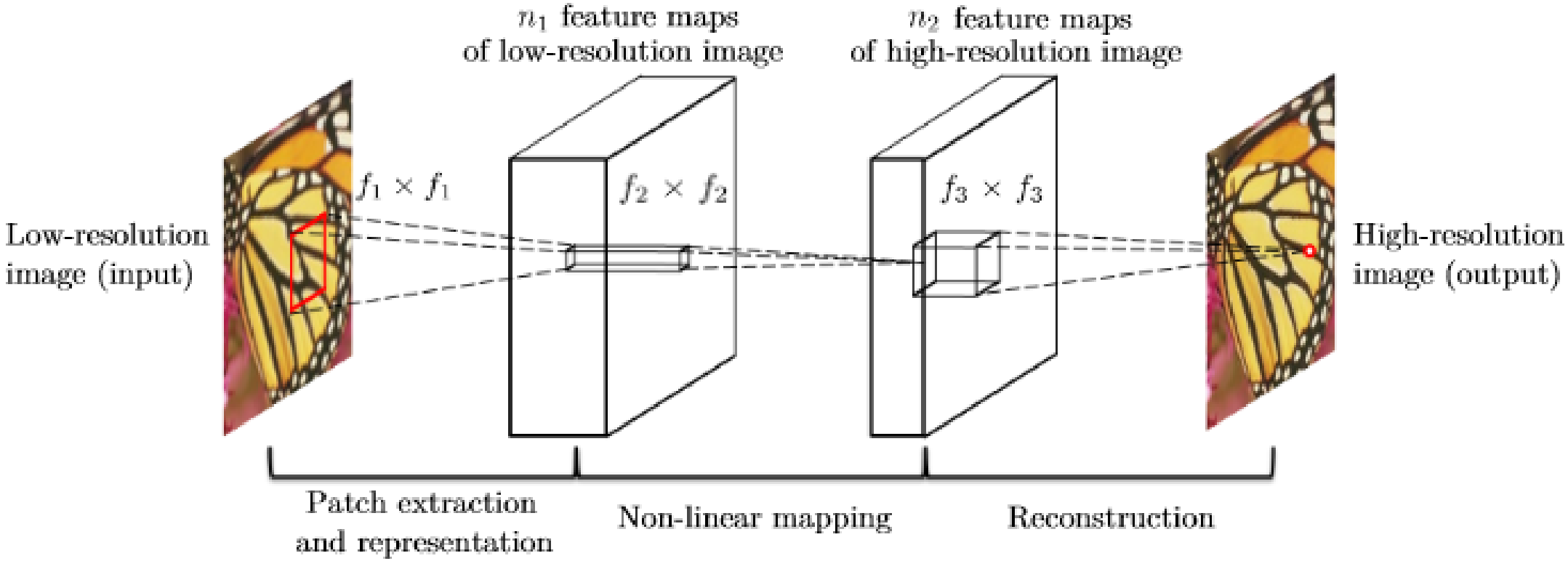
MOTIVATION

Original / PSNR

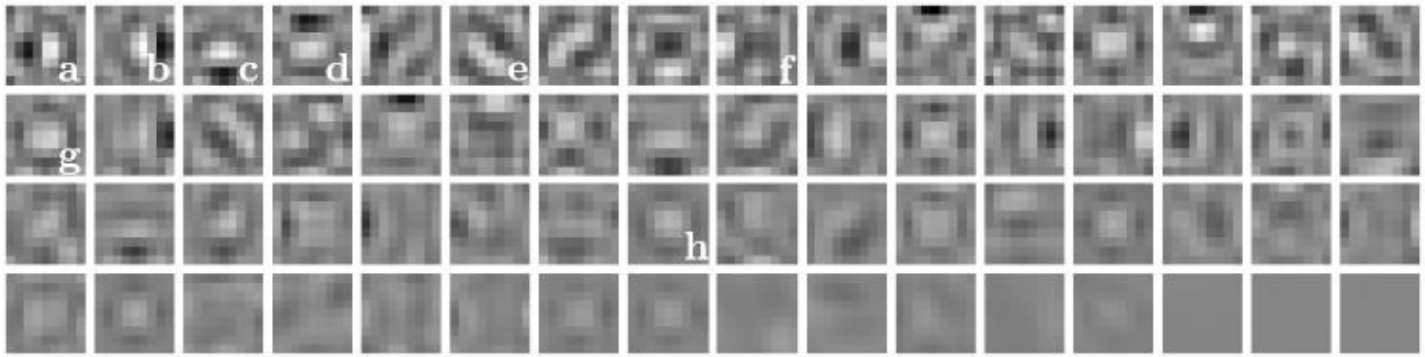
Bicubic / 24.04 dB

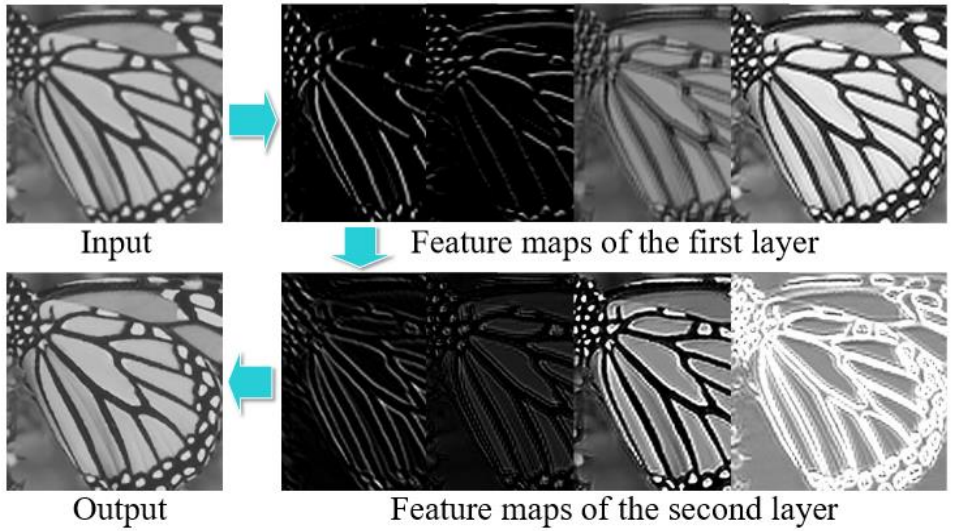
SC / 25.58 dB

SRCNN / 27.95 dB

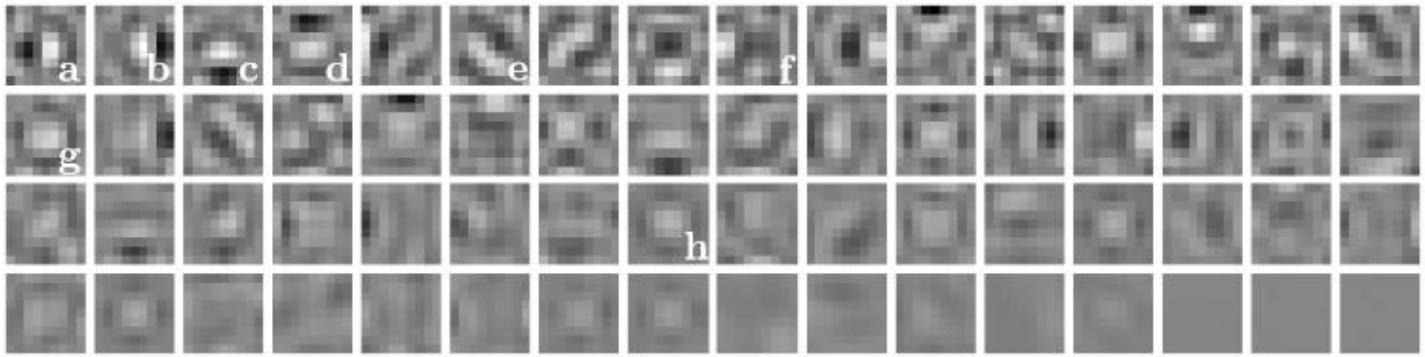

n_1 feature maps
of low-resolution image
n_2 feature maps
of high-resolution image
$f_1 \times f_1$
$f_2 \times f_2$
$f_3 \times f_3$
Low-resolution
image (input)
High-resolution
image (output)
Patch extraction
and representation
Non-linear mapping
Reconstruction

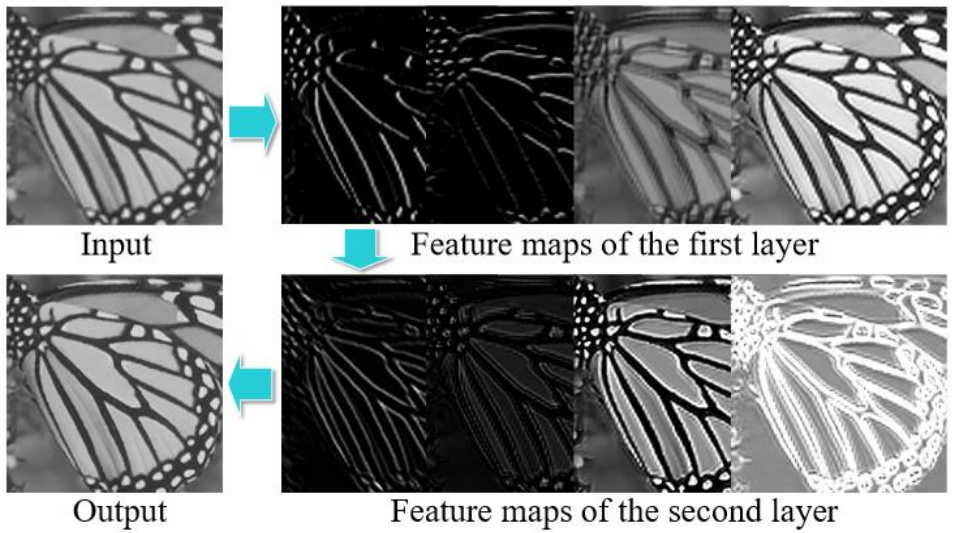
$$F_1(\mathbf{Y}) = \max(0, W_1 * \mathbf{Y} + B_1)$$



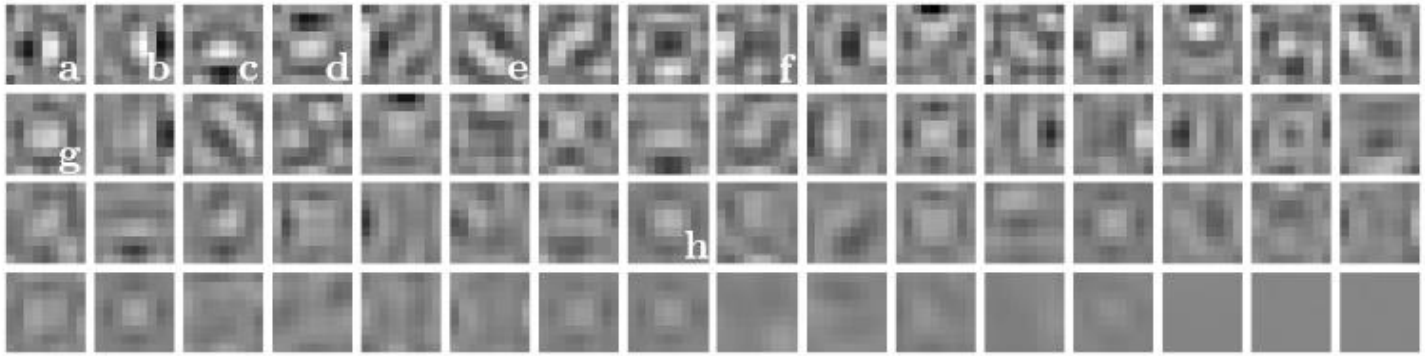


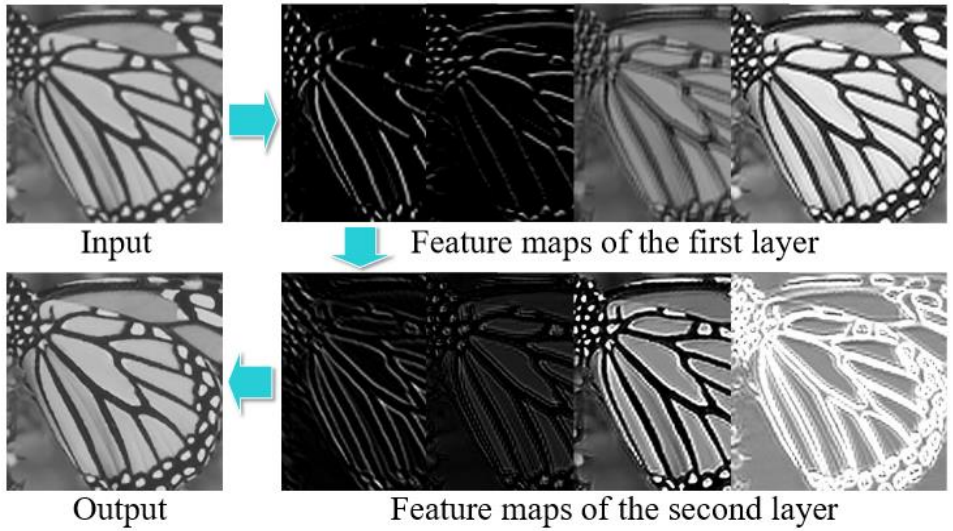
$$F_2(\mathbf{Y}) = \max(0, W_2 * F_1(\mathbf{Y}) + B_2)$$



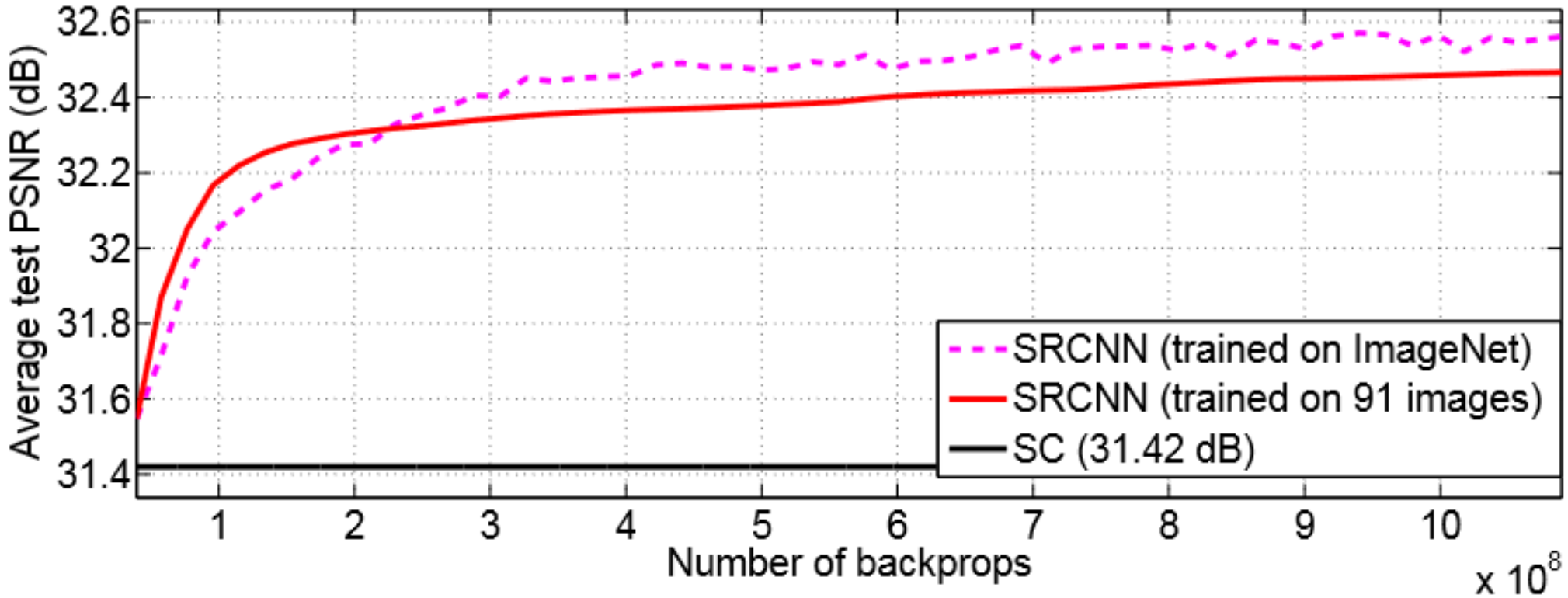


$$F(\mathbf{Y}) = W_3 * F_2(\mathbf{Y}) + B_3$$

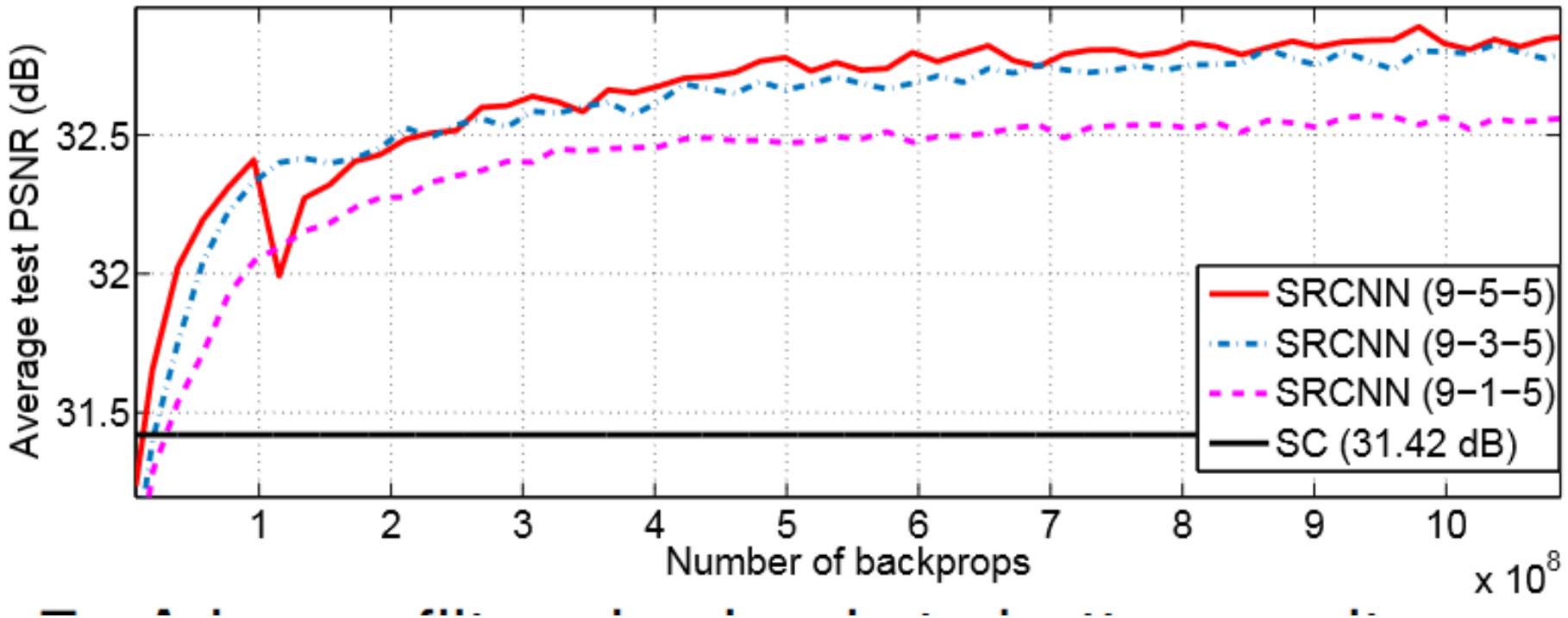


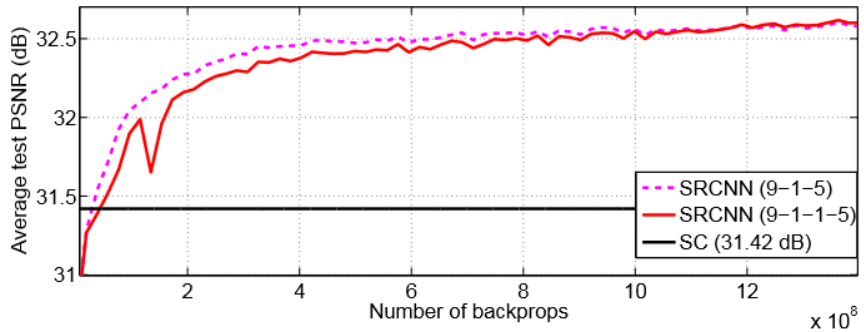


$$L(\Theta) = \frac{1}{n}\sum_{i=1}^{n} ||F(\mathbf{Y}_i; \Theta) - \mathbf{X}_i||^2$$

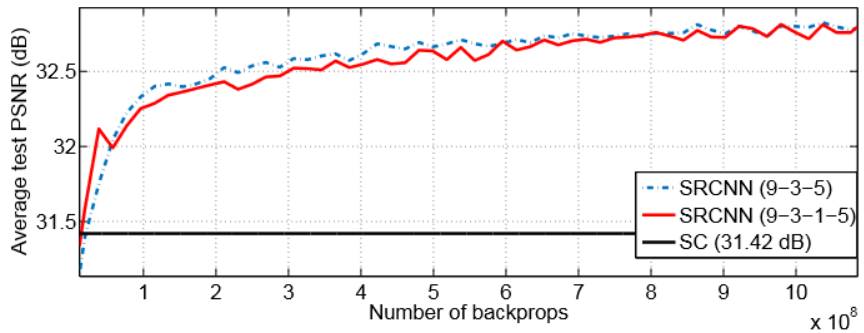

Average test PSNR (dB)
32.6
32.4
32.2
32
31.8
31.6
31.4
1
2
3
4
5
6
7
8
9
10
Number of backprops
x 10^8
SRCNN (trained on ImageNet)
SRCNN (trained on 91 images)
SC (31.42 dB)

$n_1 = 128$ $n_2 = 64$		$n_1 = 64$ $n_2 = 32$		$n_1 = 32$ $n_2 = 16$	
PSNR	Time (sec)	PSNR	Time (sec)	PSNR	Time (sec)
32.60	0.60	32.52	0.18	32.26	0.05

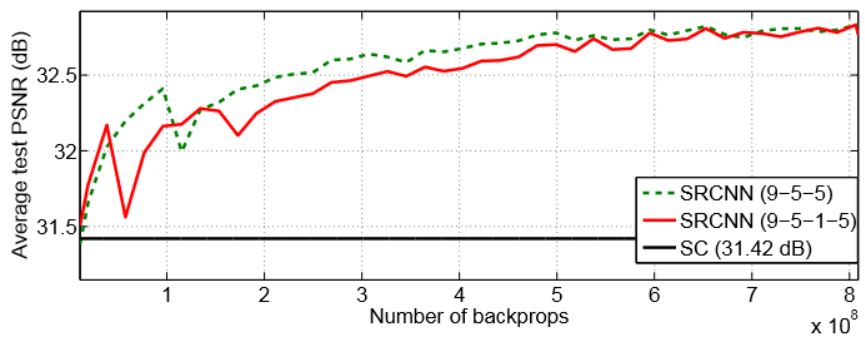

Average test PSNR (dB)
32.5
32
31.5
1
2
3
4
5
6
7
8
9
10
Number of backprops
x 10^8
SRCNN (9−5−5)
SRCNN (9−3−5)
SRCNN (9−1−5)
SC (31.42 dB)



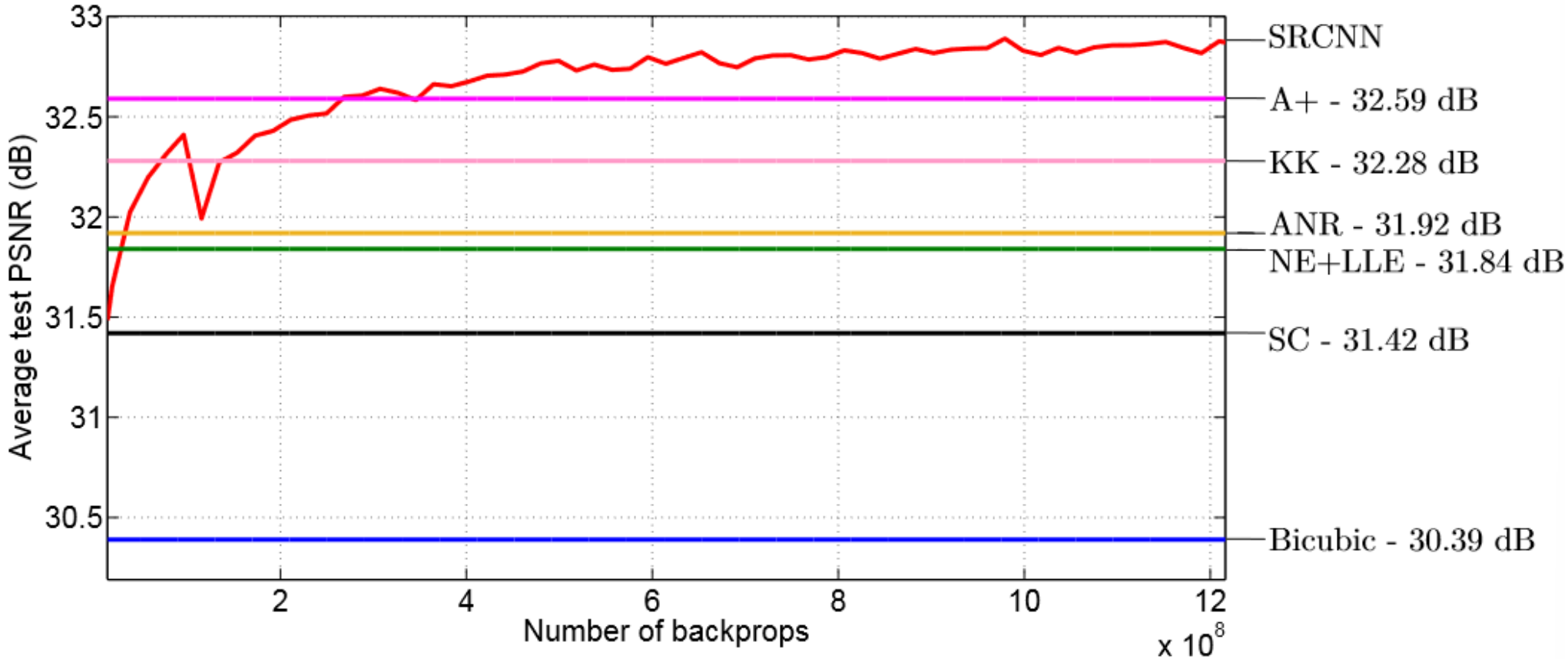
(a) 9-1-5 vs. 9-1-1-5

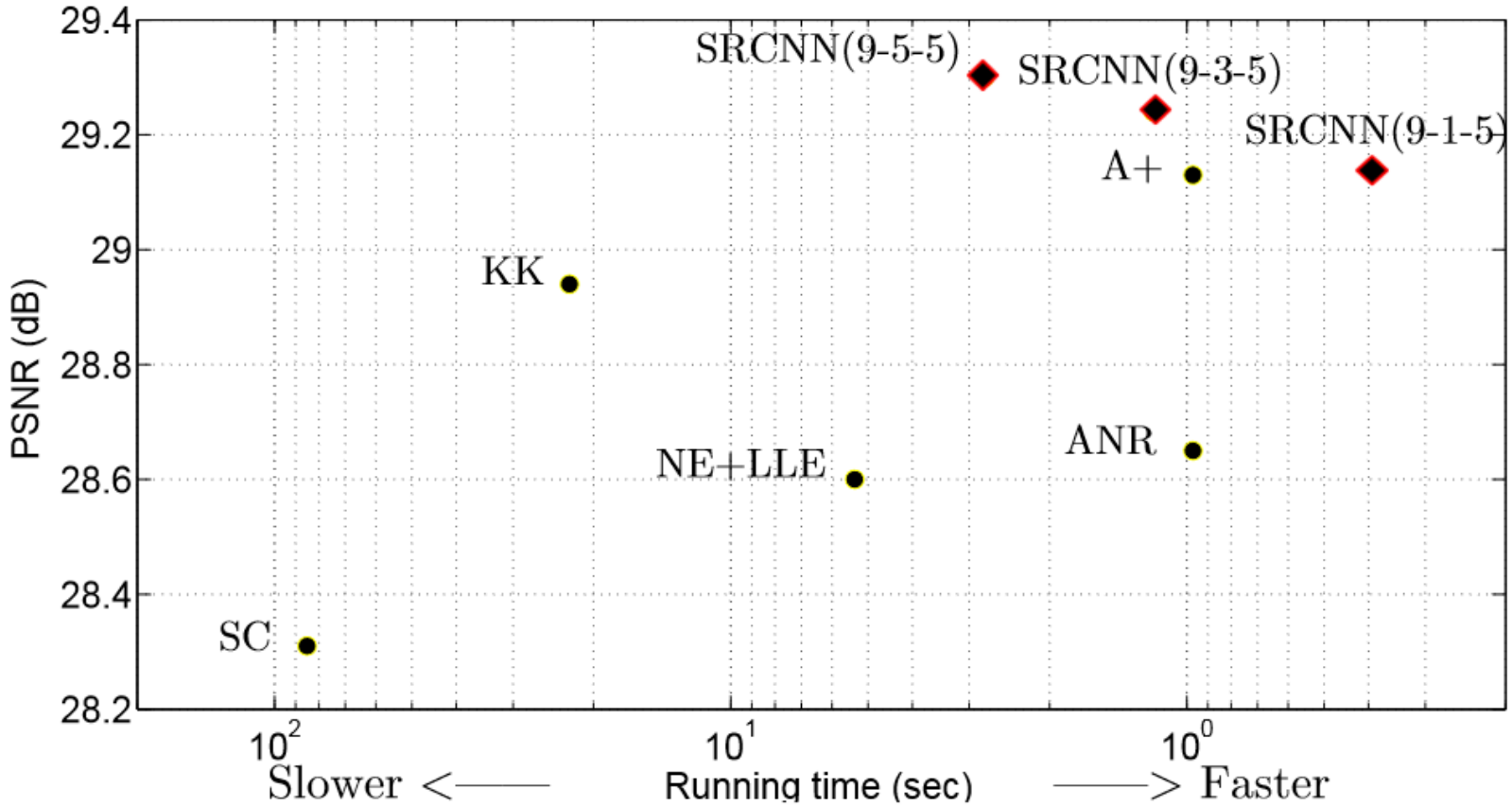


(b) 9-3-5 vs. 9-3-1-5



(c) 9-5-5 vs. 9-5-1-5


33
32.5
32
31.5
31
30.5
Average test PSNR (dB)
2
4
6
8
10
12
Number of backprops
x 10^8
SRCNN
A+ - 32.59 dB
KK - 32.28 dB
ANR - 31.92 dB
NE+LLE - 31.84 dB
SC - 31.42 dB
Bicubic - 30.39 dB


29.4
29.2
29
28.8
28.6
28.4
28.2
PSNR (dB)
SRCNN(9-5-5)
SRCNN(9-3-5)
SRCNN(9-1-5)
A+
KK
ANR
NE+LLE
SC
10^2
10^1
10^0
Slower <——
Running time (sec)
——> Faster

CONCLUSION