

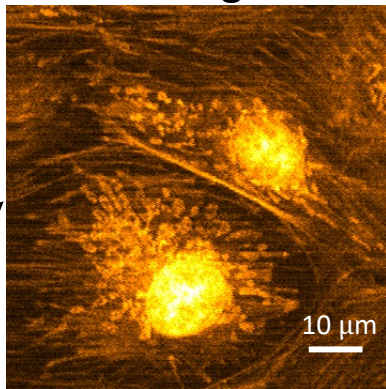
BPAE sample

Object

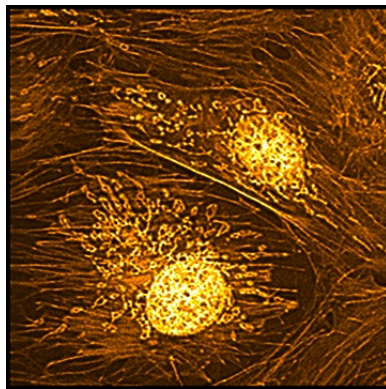
Conventional
microscope

Super-resolution
microscope

DL image



SR image



Required for the
training dataset

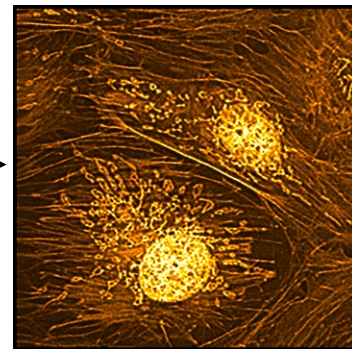
Training dataset

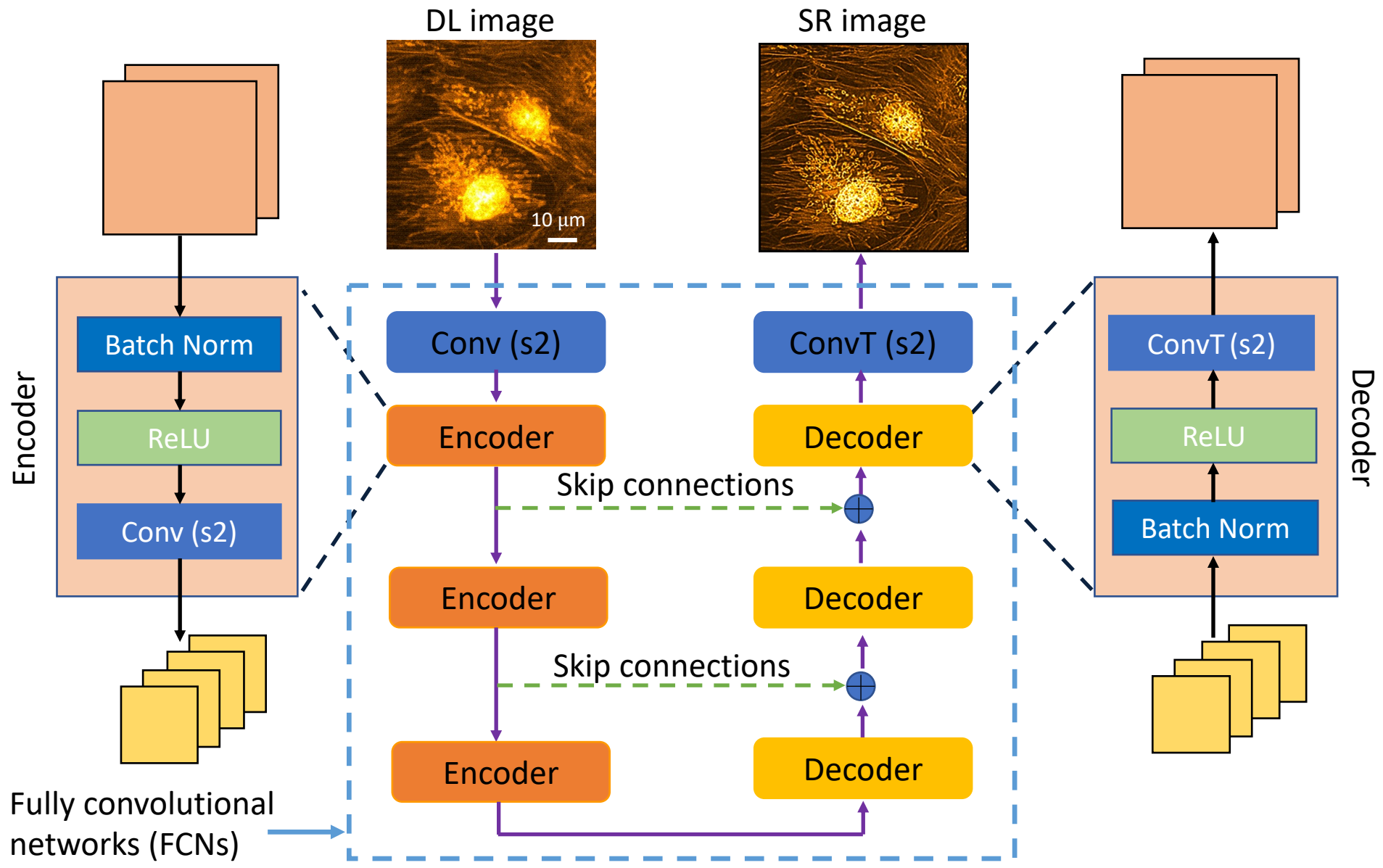
Input

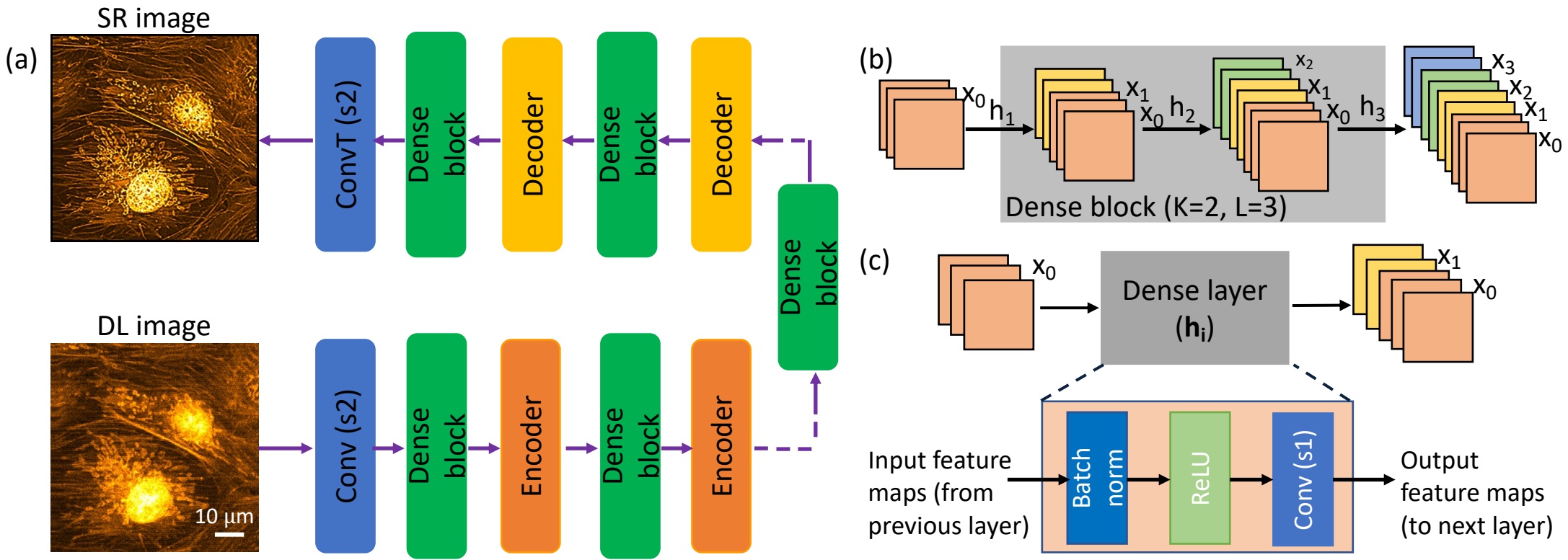
Target

Super-resolution
neural networks

Estimated SR image

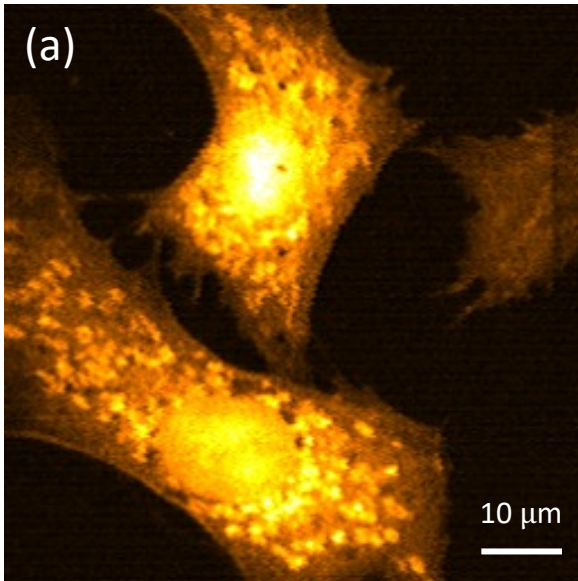






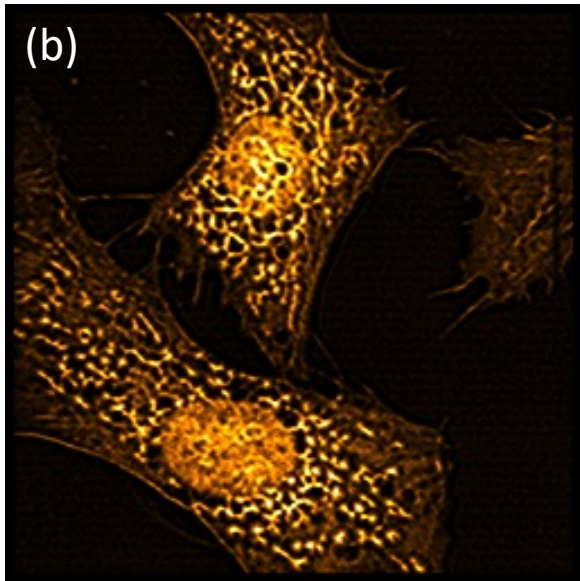
Input DL image

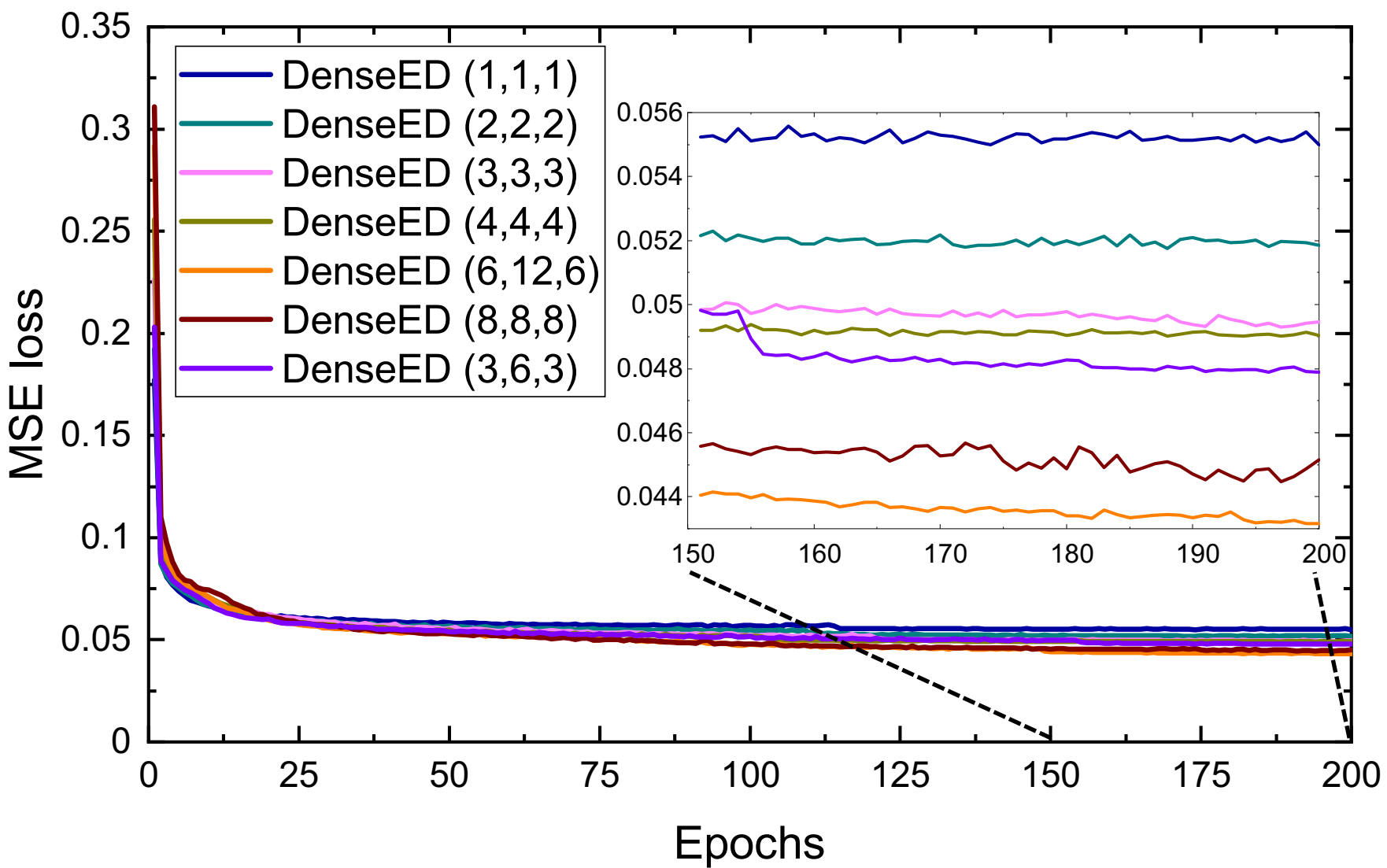
(a)



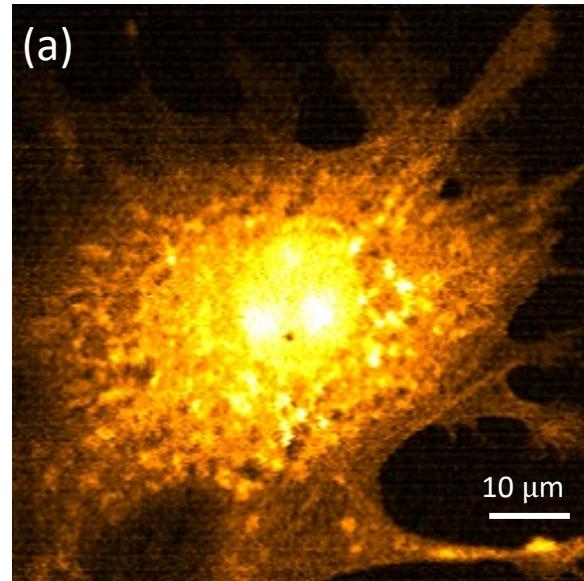
Target SR image

(b)

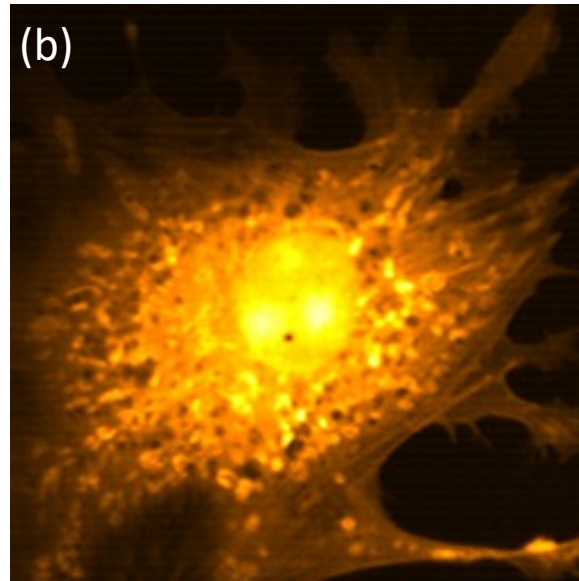




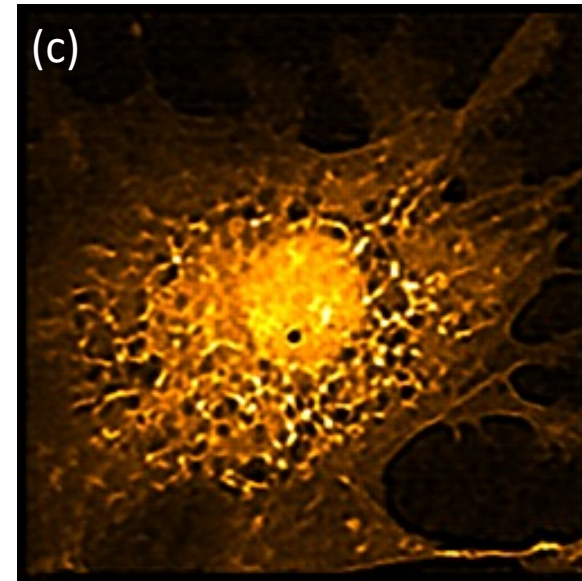
Input DL image



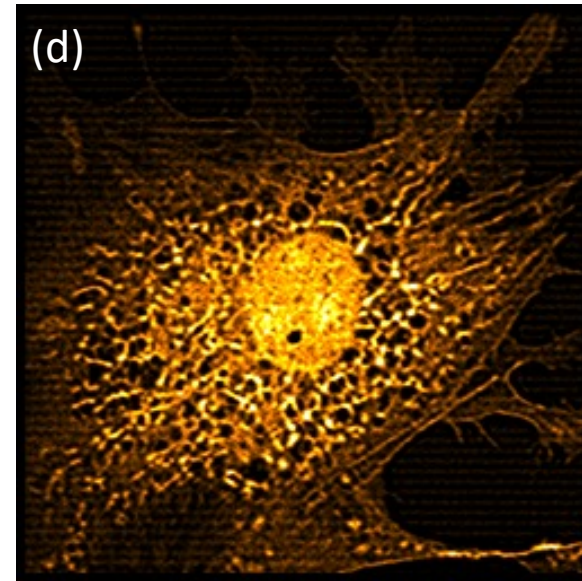
Averaged image



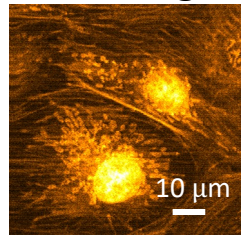
Estimated SR image



Target SR image



DL image

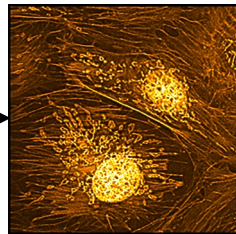


x : Input

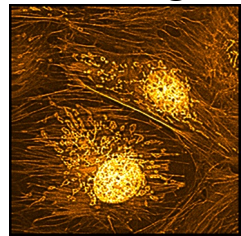
Generator

$G(x)$:
estimated

Estimated SR



SR image



y : Target

Loss (G)

MSE loss

y : Target

Discriminator

Real/Fake
image?

Loss (D)

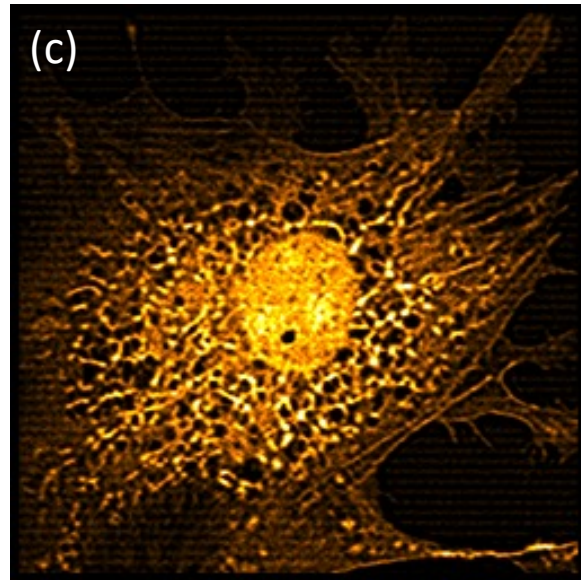
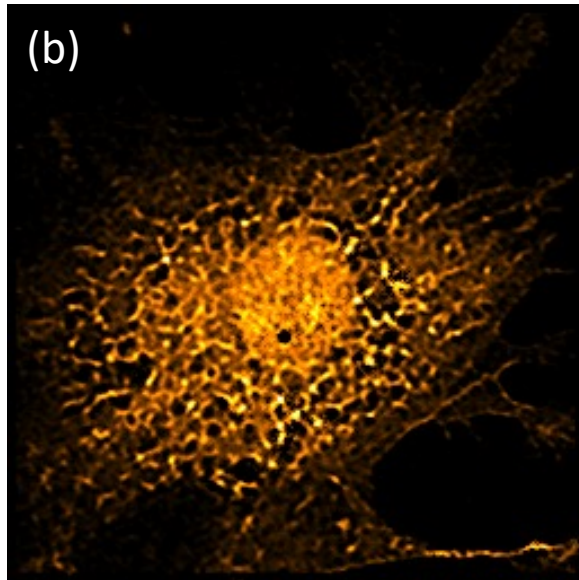
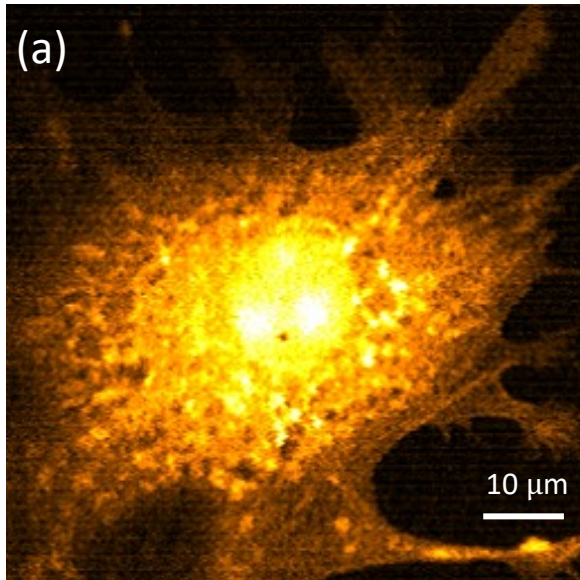
BCE loss

Loss from discriminator

Input DL image

Estimated SR image (GANs)

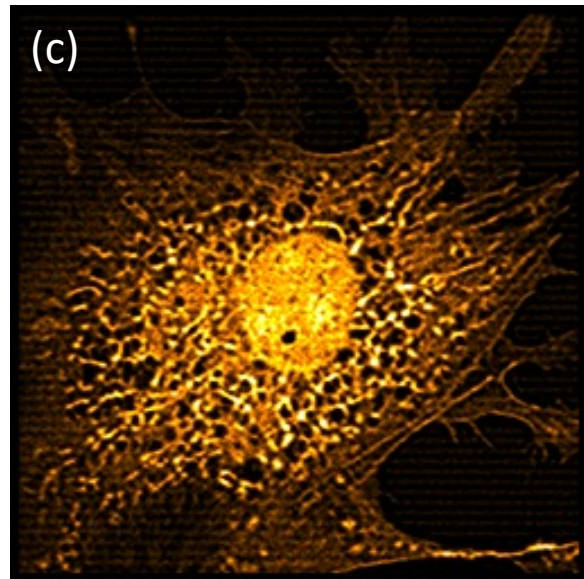
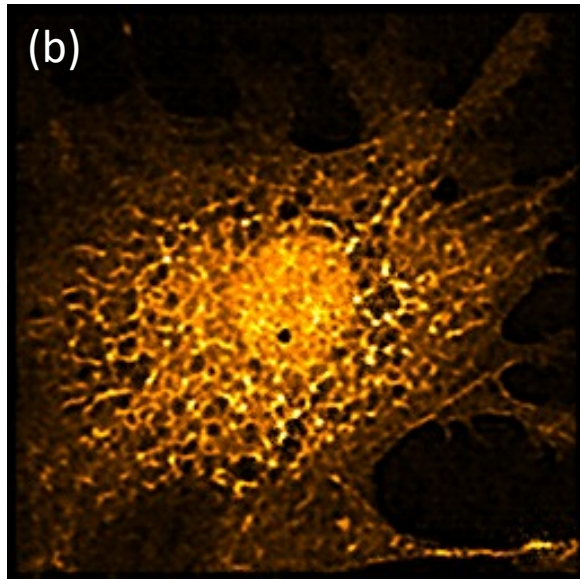
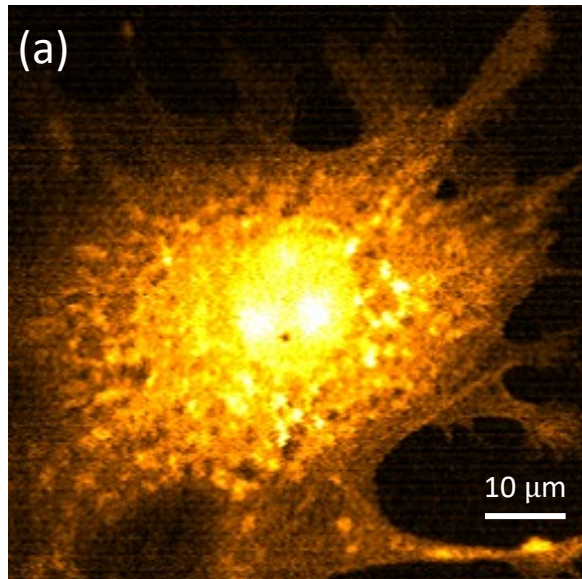
Target SR image



Input DL image

Estimated SR (DenseED GANs)

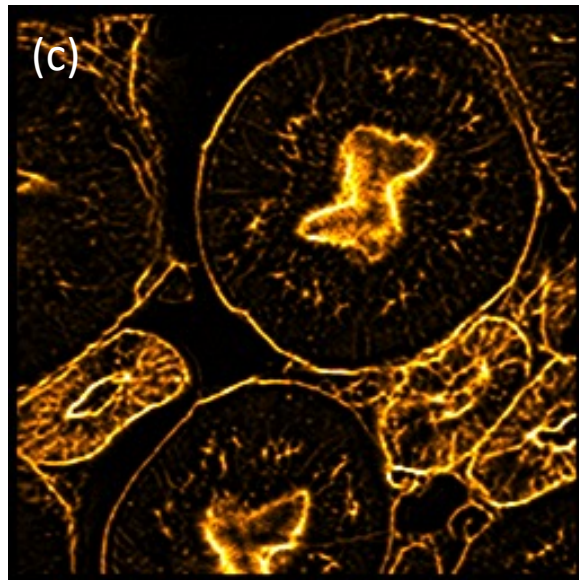
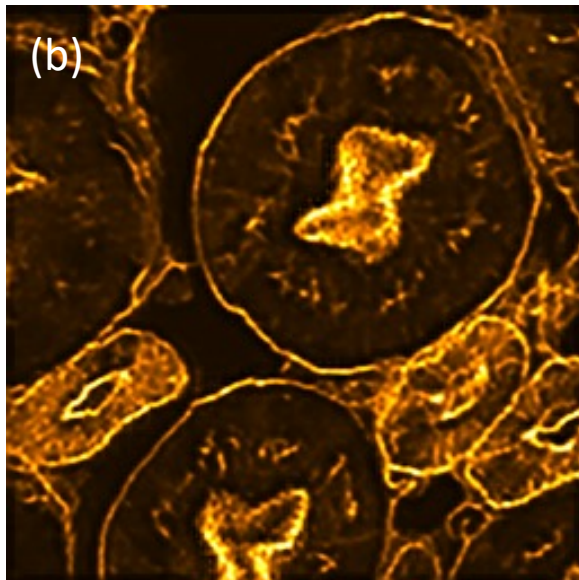
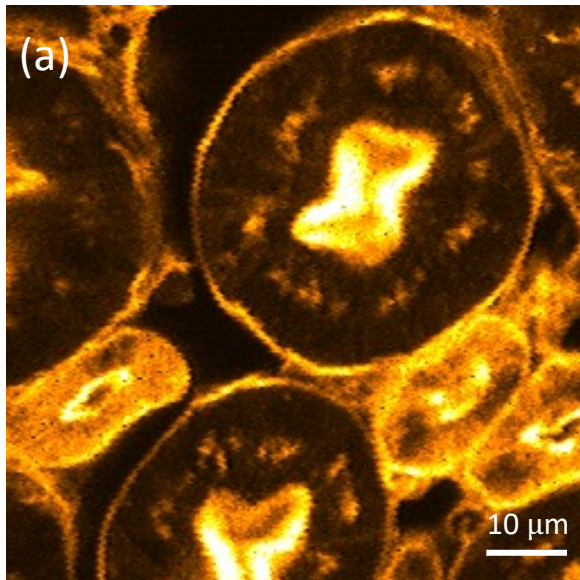
Target SR image

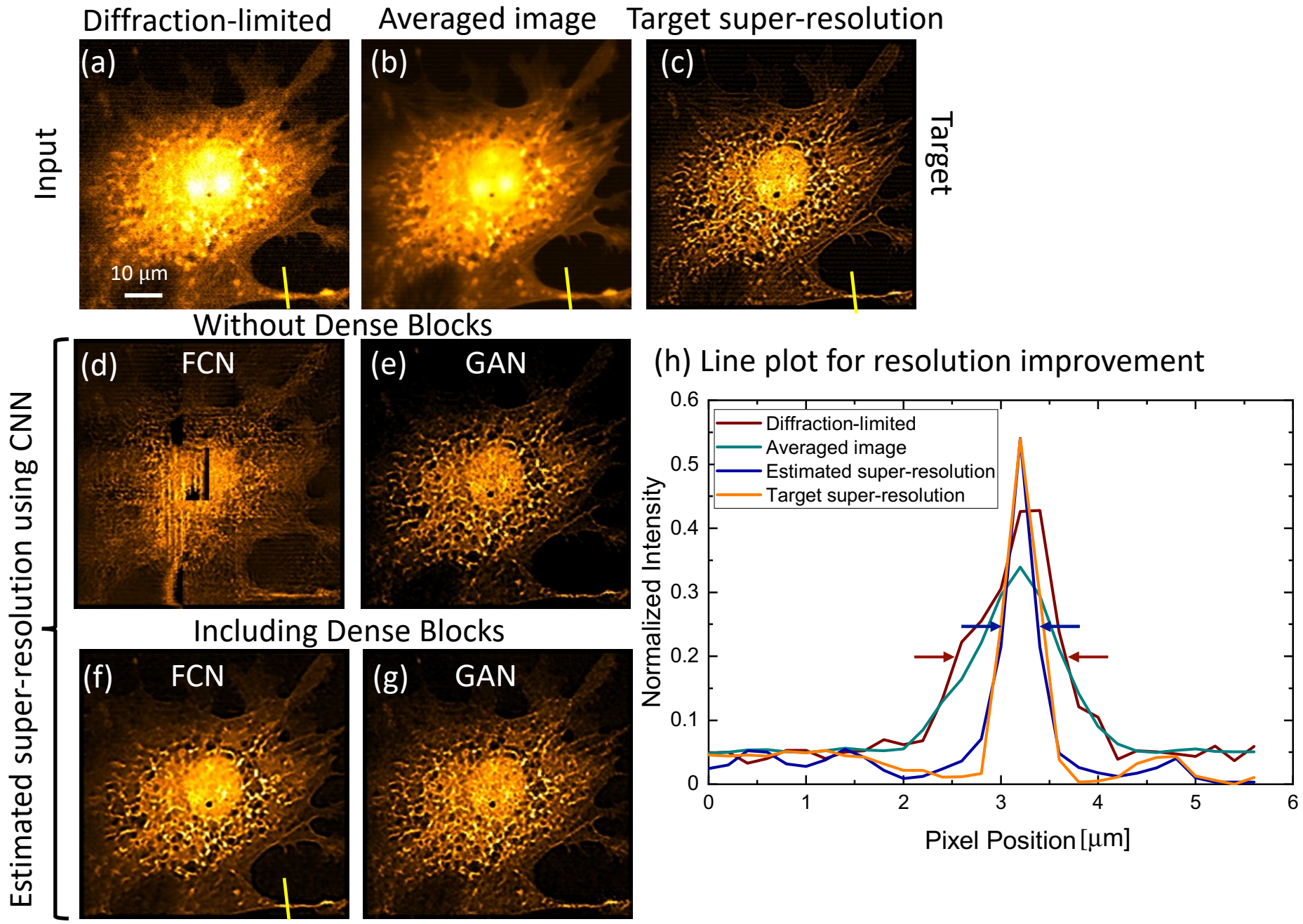


Input DL image

Estimated SR (DenseED FCNs)

Target SR image





Archit ecture	Included DenseED blocks?	DenseED configuration	Learning rate	Mixed loss?	Loss function?	Weight_0	Weight_1	Weight_2	Dataset (FOV)	Non-linear Activation	Estimated image PSNR (dB)	Estimated image SSIM
Diffraction-limited image: PSNR=21.24 dB, SSIM=0.54												
FCN	Yes	(3,6,3)	0.001	No	MSE Loss	N/A	N/A	N/A	15	ReLU	24.58	0.68
FCN	Yes	(3,6,3)	0.0005	No	MSE Loss	N/A	N/A	N/A	15	ReLU	24.50	0.70
FCN	Yes	(3,6,3)	0.0001	No	MSE Loss	N/A	N/A	N/A	15	ReLU	23.67	0.52
FCN	Yes	(3,6,3)	0.00005	No	MSE Loss	N/A	N/A	N/A	15	ReLU	24.10	0.65
FCN	Yes	(3,6,3)	0.00001	No	MSE Loss	N/A	N/A	N/A	15	ReLU	23.60	0.59
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	15	ReLU	24.16	0.69
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	15	Elu	24.13	0.69
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	15	Leaky ReLU	24.55	0.70
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	15	PReLU	24.54	0.70
FCN	Yes	(3,6,3)	0.003	Yes	MSE Loss + SSIM loss	0.2	0.8	N/A	15	ReLU	24.25	0.63
FCN	Yes	(3,6,3)	0.003	Yes	MSE Loss + SSIM loss	0.4	0.6	N/A	15	ReLU	24.38	0.66
FCN	Yes	(3,6,3)	0.003	Yes	MSE Loss + SSIM loss	0.6	0.4	N/A	15	ReLU	24.29	0.66
FCN	Yes	(3,6,3)	0.003	Yes	MSE Loss + SSIM loss	0.8	0.2	N/A	15	ReLU	24.28	0.67
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	4	ReLU	23.23	0.54
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	6	ReLU	23.81	0.66
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	8	ReLU	23.62	0.63
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	10	ReLU	24.22	0.67
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	12	ReLU	24.19	0.68
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	14	ReLU	24.06	0.68
FCN	Yes	(3,6,3)	0.003	No	MSE Loss	N/A	N/A	N/A	15	ReLU	24.11	0.67
GAN	No	N/A	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.26	0.68
GAN	No	N/A	0.0005	Yes	MSE loss + GAN loss	0.4	0.6	N/A	15	ReLU	23.98	0.66
GAN	No	N/A	0.0005	Yes	MSE loss + GAN loss	0.6	0.4	N/A	15	ReLU	24.37	0.70
GAN	No	N/A	0.0005	Yes	MSE loss + GAN loss	0.8	0.2	N/A	15	ReLU	23.95	0.67
GAN	Yes	(1,1,1)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.02	0.67
GAN	Yes	(2,2,2)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.09	0.67
GAN	Yes	(3,3,3)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.12	0.67
GAN	Yes	(4,4,4)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.12	0.68
GAN	Yes	(6,12,6)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.00	0.67
GAN	Yes	(8,8,8)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.03	0.68
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.18	0.68
GAN	Yes	(3,6,3)	0.00001	Yes	MSE loss + GAN loss	0.2	0.8	N/A	15	ReLU	24.10	0.67
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss	0.5	0.5	N/A	15	ReLU	23.94	0.68
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss	0.6	0.4	N/A	15	ReLU	24.07	0.68
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss	0.7	0.3	N/A	15	ReLU	24.20	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.5	0.3	0.2	15	ReLU	24.20	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.6	0.2	0.2	15	ReLU	24.07	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.7	0.1	0.2	15	ReLU	24.29	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.5	0.2	0.3	15	ReLU	24.28	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.6	0.1	0.3	15	ReLU	24.30	0.69
GAN	Yes	(3,6,3)	0.0005	Yes	MSE loss + GAN loss + SSIM loss	0.5	0.1	0.4	15	ReLU	24.02	0.68