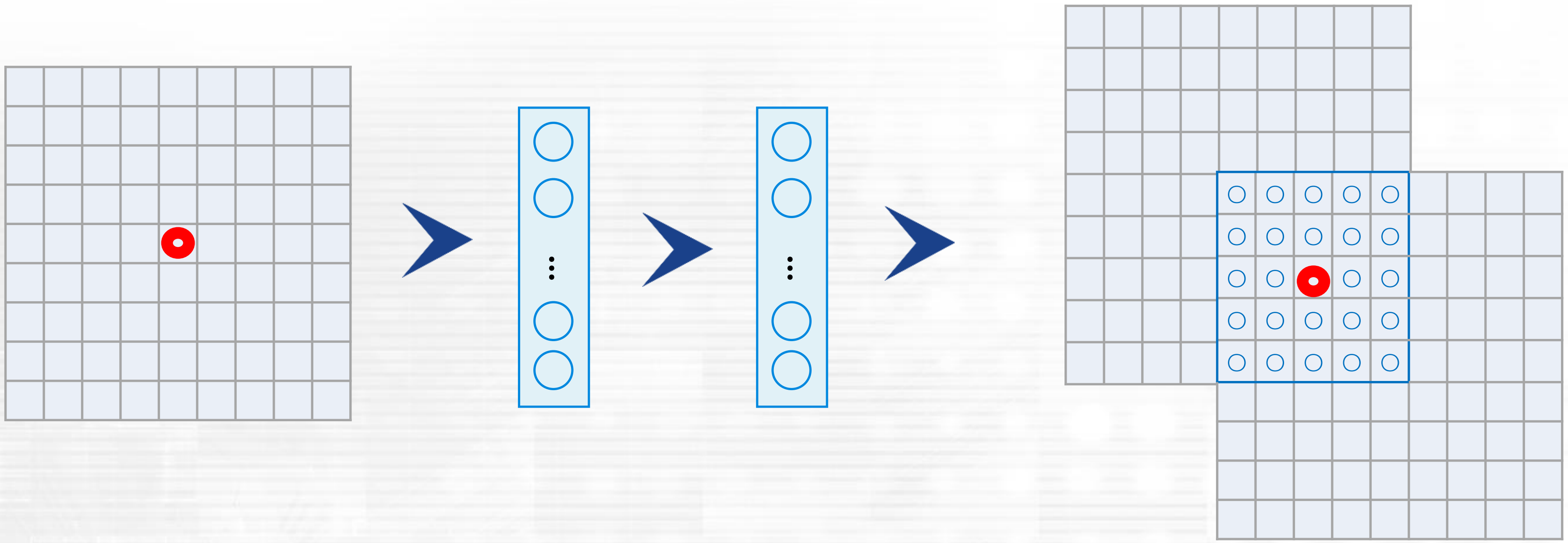
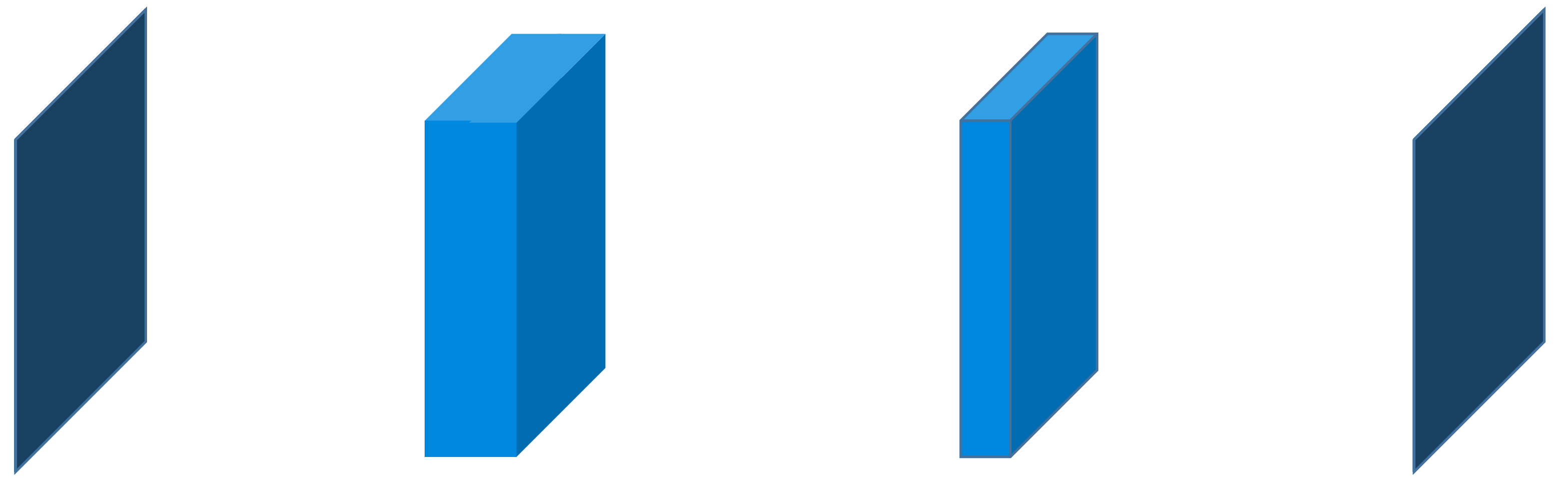
Super-Resolution using CNN

Super-Resolution using CNN



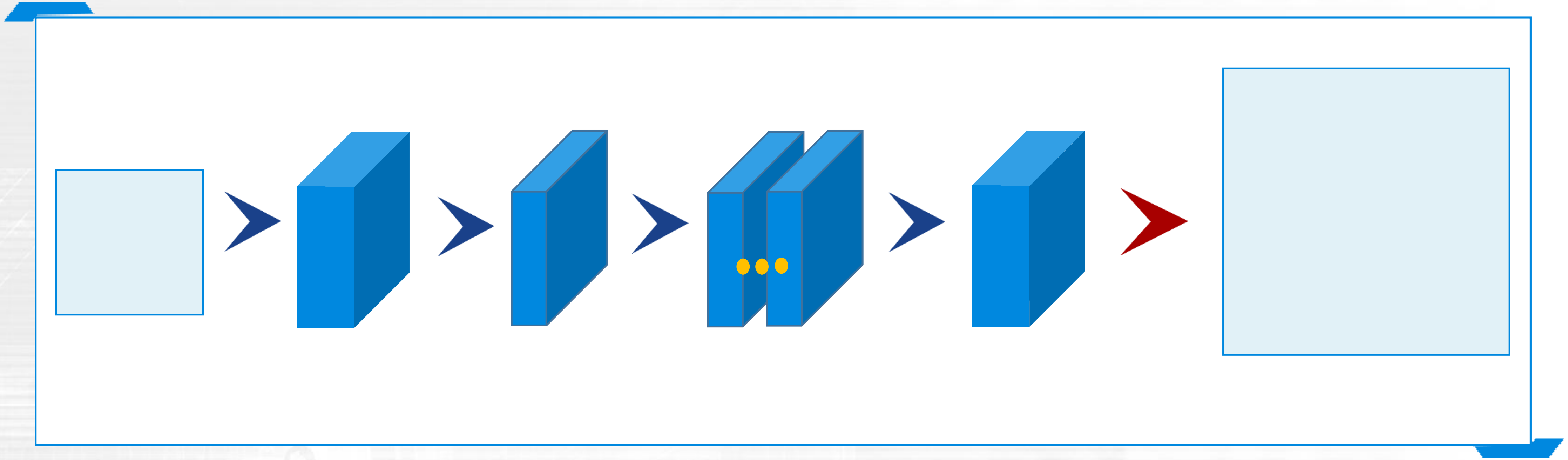
출처 Dong et al. “Image super-resolution using deep convolutional networks”, PAMI 2016

Super-Resolution using CNN



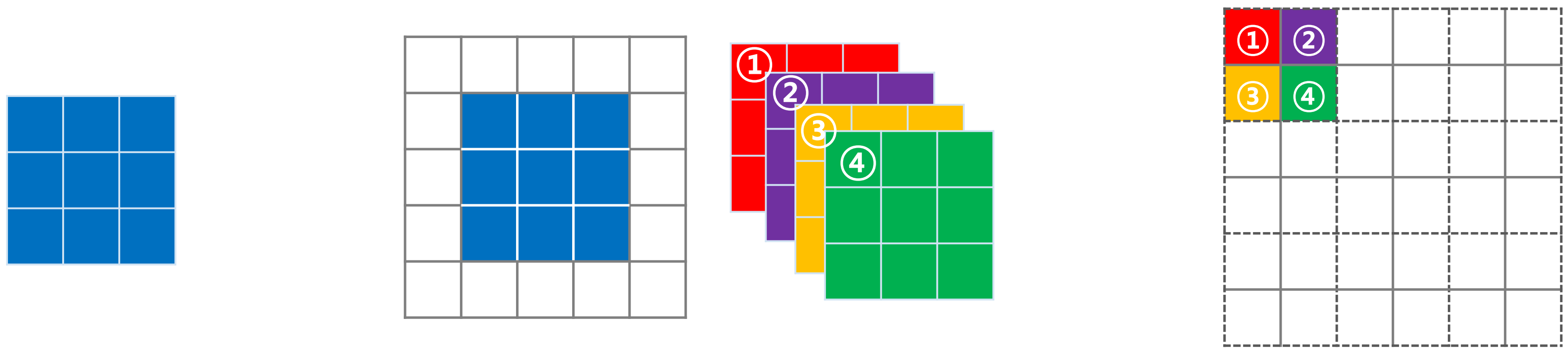
출처 Dong et al. "Image super-resolution using deep convolutional networks", PAMI 2016

Fast SRCNN



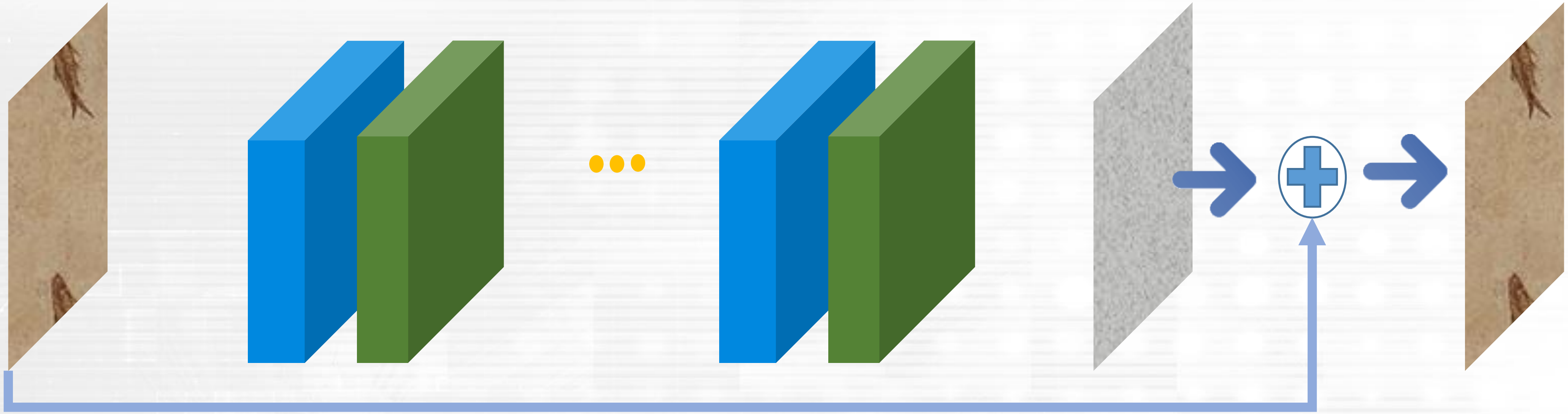
출처 Accelerating the Super-Resolution Convolutional Neural Network, ECCV 2016

Sub-Pixel CNN



출처 Real-Time Single Image and Video Super-Resolution Using an Efficient Sub-Pixel Convolutional Neural Network, CVPR 2016

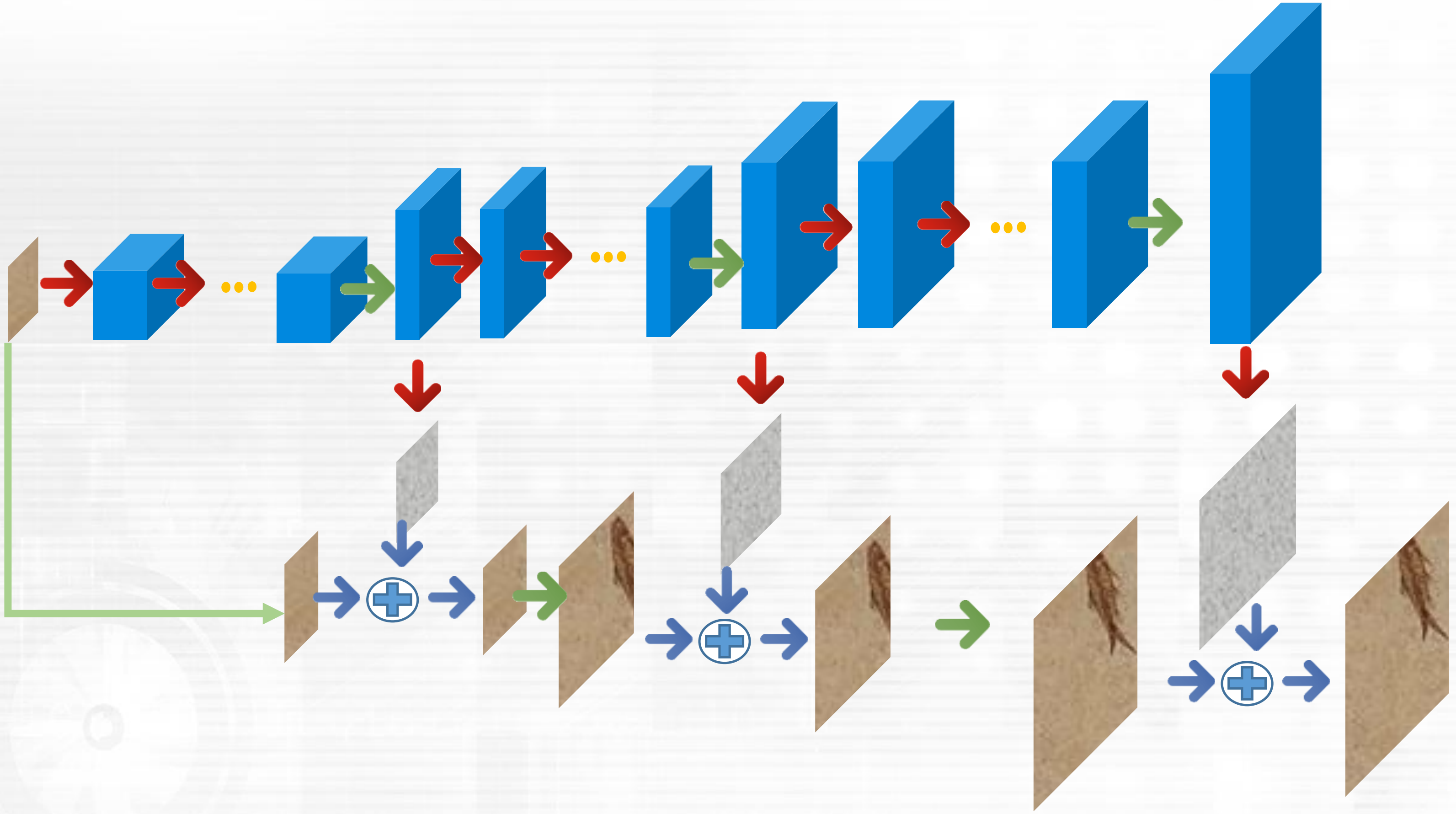
Deep CNN for Super Resolution



출처 Accurate Image Super-Resolution Using Very Deep Convolutional Networks, CVPR 2016

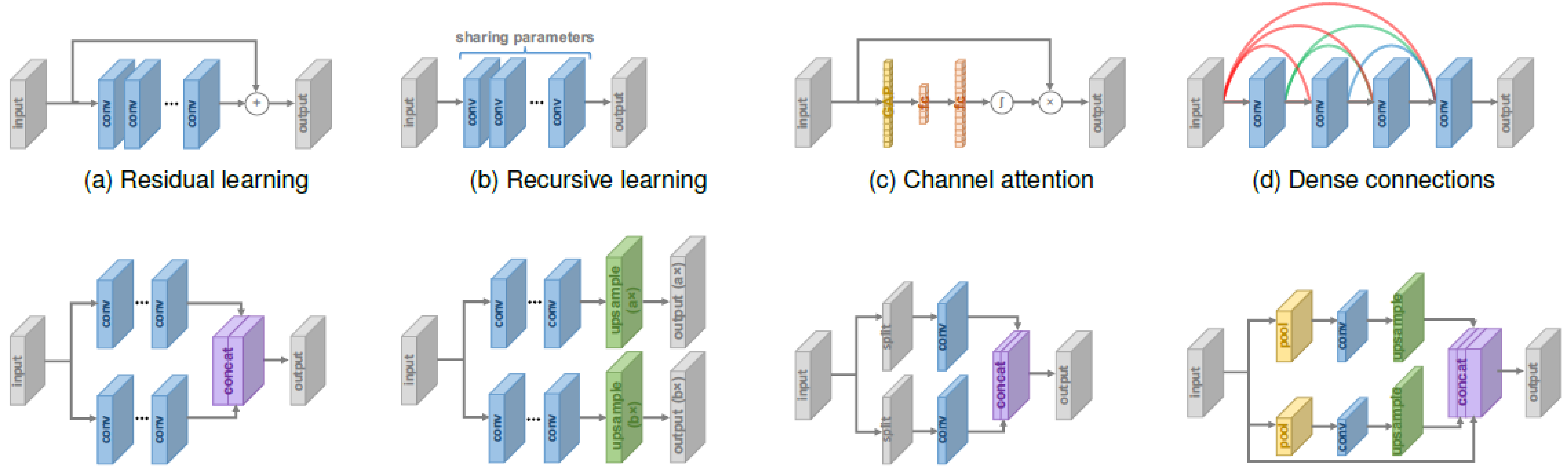
Gradient Clipping

Laplacian Pyramid Network



출처 "Deep Laplacian Pyramid Networks for Fast and Accurate Super-Resolution", CVPR 2017.

Deep Networks

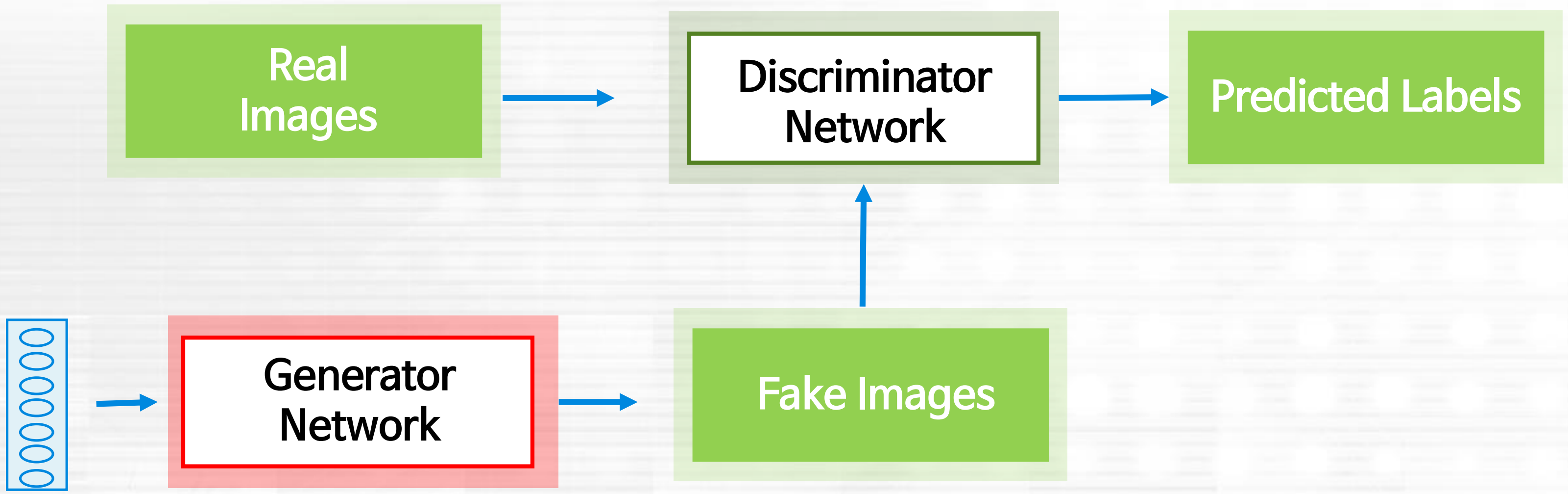


(a) Residual learning (b) Recursive learning (c) Channel attention (d) Dense connections

(e) Local multi-path learning (f) Scale-specific multi-path learning (g) Group convolution (h) Pyramid pooling

출처 Deep Learning for Image Super-resolution: A Survey, Arix 2019

Generative Adversarial Network



$$\min_{G} \max_{D} V(D, G) = \mathbb{E}_{x \sim pdata\,(x)}[logD(x)] + \mathbb{E}_{z \sim p_x\,(z)}[\log(1 - D(G(z)))]$$

출처 Generative Adversarial Nets, NIPS 2014

Conditional GAN

출처 Image-to-Image Translation with Conditional Adversarial Networks, CVPR 2017

Conditional GAN

$$\mathcal{L}_{GAN}(G,D) = \mathbb{E}_y[logD(y)] + \mathbb{E}_{x,z}[\log(1 - D(G(x,z))]$$

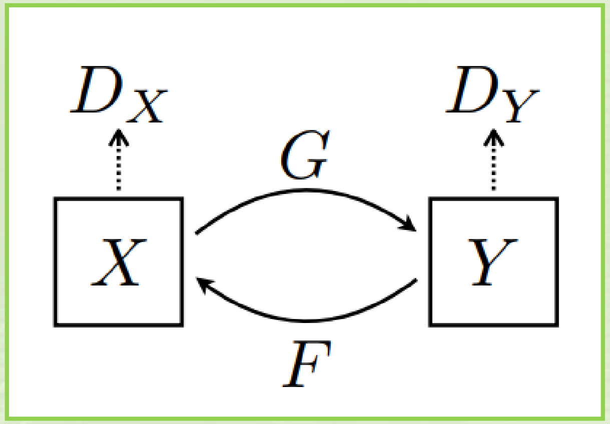
$$\mathcal{L}_{cGAN}(G,D) = \mathbb{E}_{x,y}[logD(x,y)] + \mathbb{E}_{x,z}[\log(1 - D(x,G(x,z))]$$

$$\mathcal{L}_{L1}(G) = \mathbb{E}_{x,y,z}[\| y - G(x,z) \|_1]$$

$$G^* = arg\min_G \max_D \mathcal{L}_{cGAN}(G,D) + \lambda\, \mathcal{L}_{L1}(G)$$

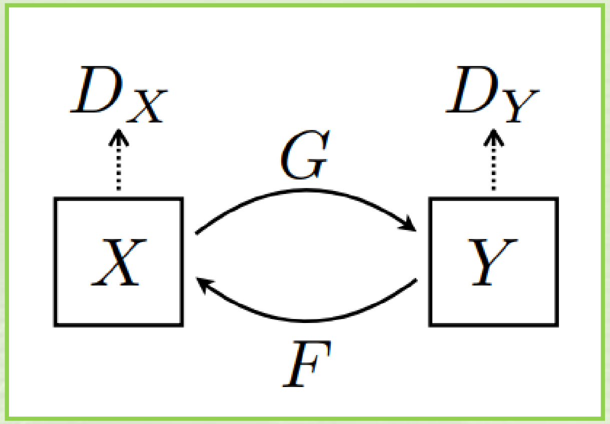
출처 Image-to-Image Translation with Conditional Adversarial Networks, CVPR 2017

Cycle GAN



출처 Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks, ICCV 2017

Cycle GAN



$$G^*, F^* = arg \min_{G,F} \max_{D_x, D_y} \mathcal{L}(G, F, D_X, D_Y)$$

$$\mathcal{L}(G, F, D_X, D_Y) = \mathcal{L}_{GAN}[G, D_Y, X, Y] + \mathcal{L}_{GAN}[F, D_X, Y, X] + \lambda \mathcal{L}_{cyc}(G, F)$$

$$\mathcal{L}_{GAN}(G, D_Y, X, Y) = \mathbb{E}_{y \sim p_{data}(y)}[log D_Y(y)] + \mathbb{E}_{x \sim p_{data}(x)}[log(1 - D_Y(G(x)))]$$

$$\mathcal{L}_{cyc}(G, F) = \mathbb{E}_{x \sim p_{data}(x)}[\| F(G(x)) - x \|_1] + \mathbb{E}_{y \sim p_{data}(y)}[\| G(F(y)) - y \|_1]$$

출처 Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks, ICCV 2017

GAN for Super Resolution

GAN for Super Resolution

$$l_{MSE}^{SR} = \frac{1}{r^2WH}\sum_{x=1}^{rW}\sum_{y=1}^{rH}(I_{x,y}^{HR} - G_{\theta_G}(I^{LR})_{x,y})^2$$

$$l_{VGG/i.j}^{SR} = \frac{1}{W_{i,j}H_{i,j}}\sum_{x=1}^{W_{i,j}}\sum_{y=1}^{H_{i,j}}(\phi_{i,j}(I^{HR})_{x,y}) - \phi_{i,j}(G_{\theta_G}(I^{LR})_{x,y})^2$$

$$l_{Gen}^{SR} = \sum_{n=1}^{N} -\log D_{\theta_G}(G_{\theta_G}(I^{LR}))$$

출처 "Photo-Realistic Single Image Super-Resolution Using a Generative Adversarial Network", 2017 CVPR

Medical Image Super-Resolution

- MRI super-resolution
- CT reconstruction

Medical Image Synthesis

- MRI - PET generation
- Data generation for better training model

Metrics for Image Quality

- Peak Signal to Noise Ratio (PSNR)

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2$$

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) = 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE)$$

Metrics for Image Quality

- Structural Similarity Index (SSIM)

$$l(x,y) = \frac{2\mu_x\mu_y + c_1}{\mu_x^2 + \mu_y^2 + c_1} \qquad c(x,y) = \frac{2\sigma_x\sigma_y + c_2}{\sigma_x^2 + \sigma_y^2 + c_2} \qquad s(x,y) = \frac{\sigma_{xy} + c_3}{\sigma_x\sigma_y + c_3}$$

$$SSIM(x,y) = [l(x,y)^{\alpha} c(x,y)^{\beta} s(x,y)^{\gamma}] \qquad c_3 = c_2/2$$

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

Metrics for Image Quality

- Mean Opinion Score (MOS)