Deep Learning and Computer Vision

Image Super-resolution Using Deep Learning

1. **Suppose the settings of a SRCNN as: f1=9, f2=3, f3=5, how many pixels of the low-resolution image are utilized to reconstruct a pixel of the high-resolution image with the SRCNN?**

$$\begin{aligned}\text{Number of pixels} &= (f1 + (f2 - 1) + (f3 - 1)^2) \\ &= (9 + (3 - 1) + (5 - 1)^2) \\ &= \mathbf{225}\ \boldsymbol{px}\end{aligned}$$

2. **Why the deep convolutional neural network is superior to perform image super-resolution? Give one reason to explain it.**

   a) The end-to-end mapping between the low- and high-resolution images allows the optimization of the complete development pipeline within a Convolutional Neural Network. This improves the processing time by optimizing the pre/post-process including patch extraction and aggregation resulting in a higher quality image whilst decreasing training time.

3. **Please explain the meaning of peak signal-to-noise ratio (PSNR) in the context of image super-resolution. PS: give the ground truth (GT) image, and the high-resolution images by SCRNN (HR-SRCNN) and interpolation (HR-Base) for reference. Also put the PSNR value below the high-resolution images.**

GT

HR-Base (PSNR=20.4976)

HR-SRCNN (PSNR=22.9227)

Peak signal-to-noise ratio (PSNR) is a qualitative measure of the difference between the original low-resolution image as compared to the updated high-resolution image.

Mathematically, it is defined in the logarithmic decibel scale (to aid comparison for large signal values) as the ratio between the maximum intensity value of the pixels of the original image (MAX_f) and the power of the distorting noise that is emblematic of the quality of the image representation (scalar value derived using the mean squared error (MSE) technique). The higher the PSNR, the greater the image restoration.

$$\mathbf{PSNR} = \mathbf{20}\log_{\mathbf{10}}\frac{\mathbf{MAX}_f}{\sqrt{\mathbf{MSE}}}$$