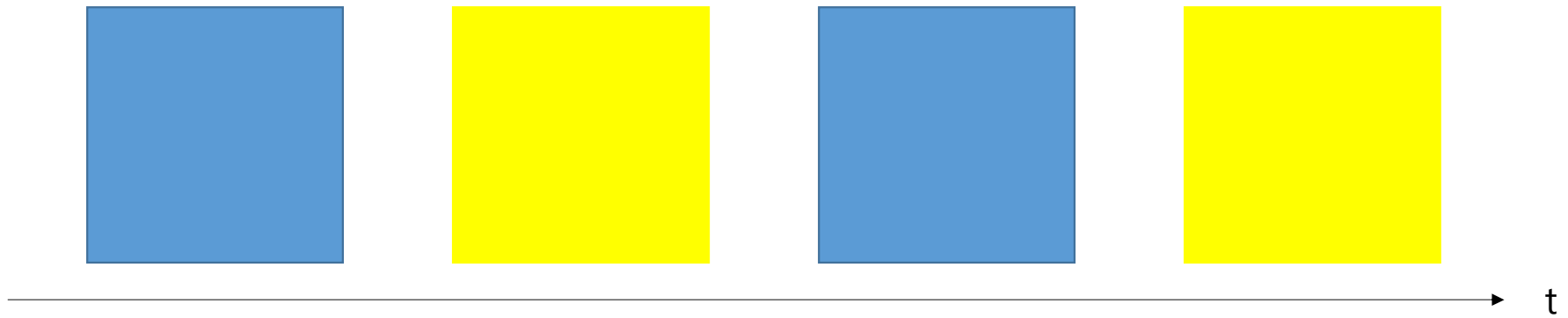# Quality Evaluation

이진영

Subjective Quality

- Mean Opinion Score, MOS

- Excellent, Good, Fair, Poor, Bad for each videos

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Objective Quality

- Peak Signal-to-Noise Ratio, PSNR

- Objective measurement of image quality

- Mean Squared Error, **MSE = Sigma(Original – Output)^2 / #Pixels**

$$\frac{\sum_{j=1,i=1}^{j=h,i=w}(Org-Out)^2}{w \times h}$$

- **PSNR = 10·log$_{10}$ (MAX^2 / MSE)**, MAX = $2^{\text{bit-depth}}$ – 1 (255 for 8 bit images)

```
double mse = 0, psnr;
for (int j = 0; j < height; j++)
{
    for (int i = 0; i < width; i++)
    {
        mse += (double)((Y2[j * width + i] - Y1[j * width + i]) * (Y2[j * width + i] - Y1[j * width + i]));
    }
}

mse /= (width * height);
psnr = mse != 0.0 ? 10.0 * log10(255 * 255 / mse) : 99.99;
printf("MSE = %.2lf\nPSNR = %.2lf dB\n", mse, psnr);
```
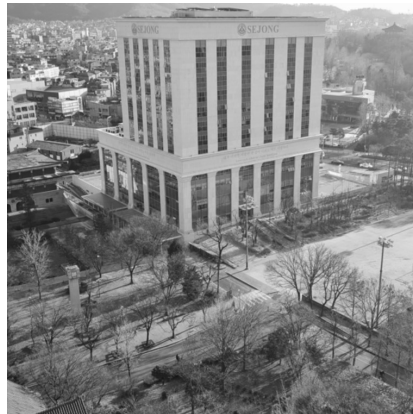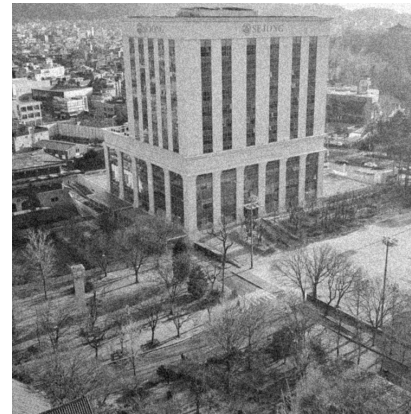
Experiment

- PSNR of AICenter_Noise.bmp, when AICenter.bmp is an original image

- Conversion from RGB to YCbCr, if an input is a color image

- No conversion, if an input is a luminance(Y) image
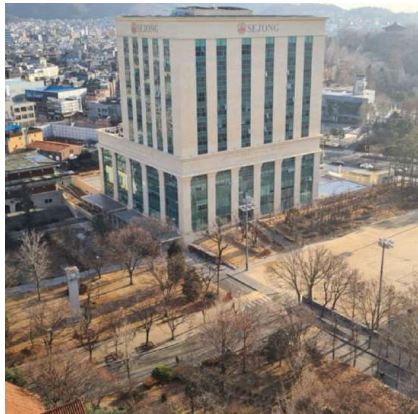
AICenter.bmp

AICenterY.bmp

AICenterY_Noise.bmp

250.88 (24.14dB)

Implementation

```
inputFile1 = fopen("AICenterY.bmp", "rb");
fread(&bmpFile1, sizeof(BITMAPFILEHEADER), 1, inputFile1);
fread(&bmpInfo1, sizeof(BITMAPINFOHEADER), 1, inputFile1);
inputFile2 = fopen("AICenterY_Noise.bmp", "rb");
fread(&bmpFile2, sizeof(BITMAPFILEHEADER), 1, inputFile2);
fread(&bmpInfo2, sizeof(BITMAPINFOHEADER), 1, inputFile2);
```

250.88 (24.14dB)

```
Y = 0.299 * inputImg1[j * stride + 3 * i + 2] + 0.587 * inputImg1[j * stride + 3 * i + 1] + 0.114 * inputImg1[j * stride + 3 * i + 0];
Y1[j * width + i] = (unsigned char)(Y > 255 ? 255 : (Y < 0 ? 0 : Y));
//Y = 0.299 * inputImg2[j * stride + 3 * i + 2] + 0.587 * inputImg2[j * stride + 3 * i + 1] + 0.114 * inputImg2[j * stride + 3 * i + 0];
Y2[j * width + i] = inputImg2[j * stride + 3 * i + 0];// (unsigned char)(Y > 255 ? 255 : (Y < 0 ? 0 : Y));
```

InputImg1=Color, InputImg2=Luminance

250.88 (24.14dB)

```
// Y = 0.299 * inputImg1[j * stride + 3 * i + 2] + 0.587 * inputImg1[j * stride + 3 * i + 1] + 0.114 * inputImg1[j * stride + 3 * i + 0];
 Y1[j * width + i] = inputImg1[j * stride + 3 * i + 0];// (unsigned char)(Y > 255 ? 255 : (Y < 0 ? 0 : Y));
 //Y = 0.299 * inputImg2[j * stride + 3 * i + 2] + 0.587 * inputImg2[j * stride + 3 * i + 1] + 0.114 * inputImg2[j * stride + 3 * i + 0];
 Y2[j * width + i] = inputImg2[j * stride + 3 * i + 0];// (unsigned char)(Y > 255 ? 255 : (Y < 0 ? 0 : Y));
```

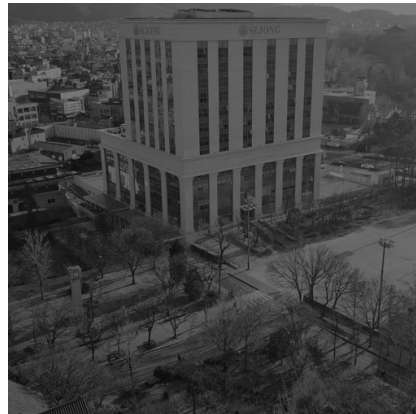InputImg1=Luminance, InputImg2=Luminance

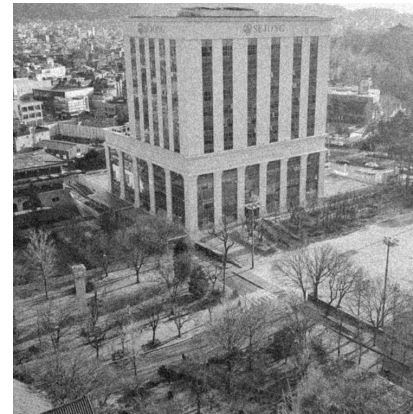SEJONG UNIVERSITY

What is Better?

- Comparison based on PSNR

- Comparison based on MOS

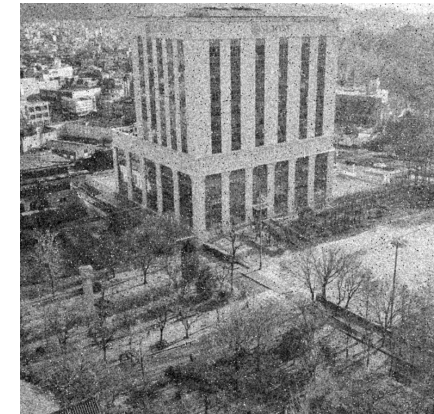- Which image shows better quality? ① Dark.bmp, ② Noise.bmp, ③ CombinedNoise.bmp

AICenterY.bmp   AICenterY_Dark.bmp   AICenterY_Noise.bmp   AICenterY_CombinedNoise.bmp

250.88 (24.14dB)