AI2619 Digital Signal and Image Processing
Lab 1: Image Restoration

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1 Blur Image

We construct a PSF (Point Spread Function) as follow

```
psf = 0.04 * ones(5);
```

Convolute the original image with PSF as follow

```
blurred = conv2(image, psf)
```

Then we get the blurred image. This part can also be implemented using `imfilter` function.

2 Insert Guassian Noise

Install `Communication Toolbox` and Guassian noise can be inserted by

```
noised_xdb = awgn(blurred, x);
```

This can also be implemented using `imnoise` function, which receives the variance of noise instead of signal-to-noise ratio as parameter.

3 Restore Image

For inverse filtering, use the formula $\boldsymbol{x} = \mathscr{F}^{-1}\left\{\dfrac{\mathscr{F}(\boldsymbol{b})}{\mathscr{F}(\boldsymbol{c})}\right\}$ together with function `fft2` and `ifft2`

```
PSF = fft2(psf);
inverse_blurred = ifft2(fft2(blurred) ./ PSF);
```

Install `Image Processing Toolbox`. Wiener filtering can be implemented by `deconvwnr` function with noise-to-signal ratio measured

```
var_image = var(image(:));
wiener_blurred = deconvwnr(blurred, psf, var(blurred(:)) / var_image);
```

We also rescale the brightness for observing. Inspect `Code.m` for detailed implementation. Image results will be attached in appendices, which shows that inverse filtering fails completely with a little noise, while Wiener filtering has relatively better performance.

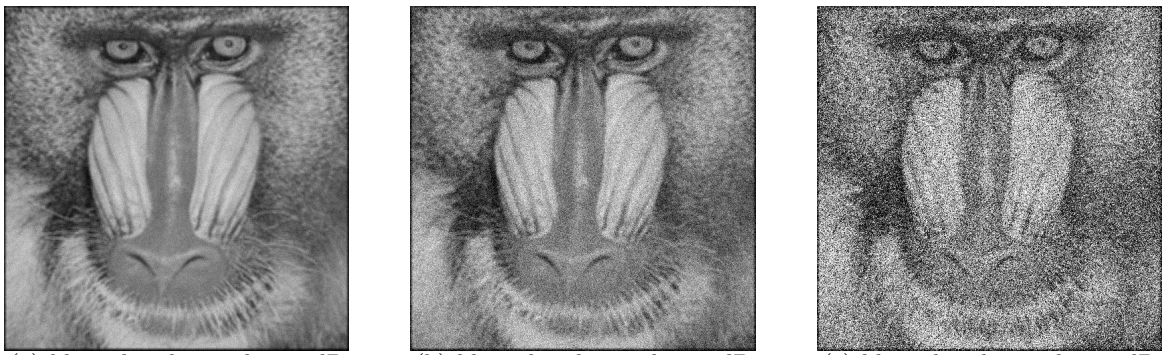
Appendix A Image Results

A.1 Blur Image

(a) original (b) blurred

Figure 1: Blur Image

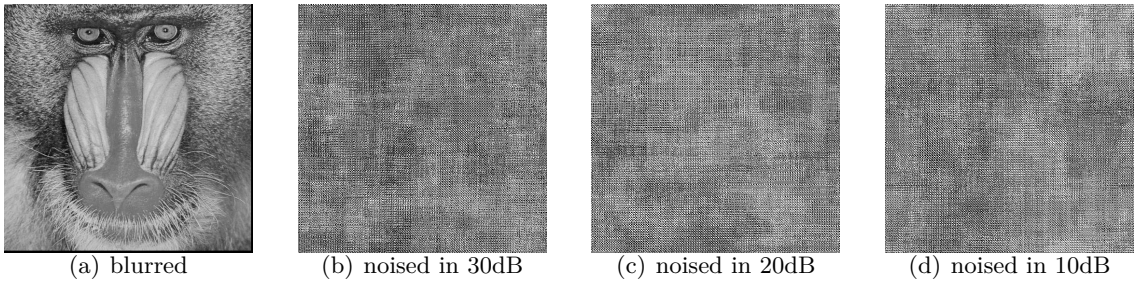
A.2 Insert Guassian Noise



(a) blurred and noised in 30dB (b) blurred and noised in 20dB (c) blurred and noised in 10dB

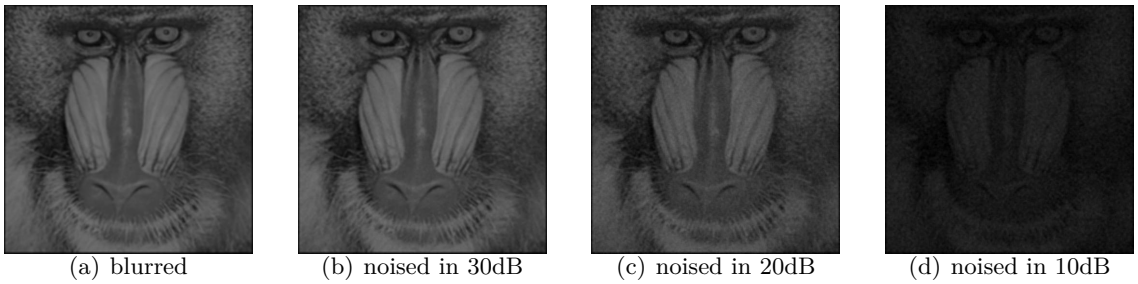
Figure 2: Insert Guassian Noise

A.3 Restore Image



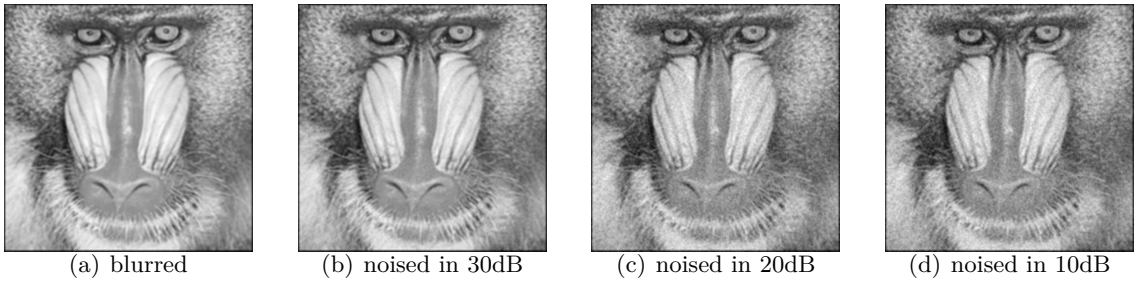
(a) blurred (b) noised in 30dB (c) noised in 20dB (d) noised in 10dB

Figure 3: Restore Image by Inverse Filtering



(a) blurred (b) noised in 30dB (c) noised in 20dB (d) noised in 10dB

Figure 4: Restore Image by Wiener Filtering



(a) blurred (b) noised in 30dB (c) noised in 20dB (d) noised in 10dB

Figure 5: Restore Image by Wiener Filtering (Rescaled)