Blur

- Atmospheric blur, Motion blur(Relative motion between camera and the object)
- A practical linear model :

$$g = i * b + n. \tag{1}$$

  Where i is the original image, b is the point spread function, n is the AWGN, g is the captured image and $*$ is the convolution operation.

- Quality of restoration depends on how well the degradation process is modeled.

Exercises

[**L6.E.1**] Let G, I, B, N be fourier transforms of g, i, b, n respectively. Let us translate the Eq.1 to fourier domain $G = I.B + N$ and hence $I = G/B - N/B$. This involves inversion of B and since B corresponds to a low pass filter it will have zero crossings. These zeros make inversion of B difficult. We may threshold the values close to zero in B to some small value α. This results in loss of information.

- Let us begin with a case without noise and let b be a 4×4 uniform averaging kernel. *Blur* `image.jpg`. Invert B and perform debluring.
- Add white gaussian noise of variance 5. Comment on the deblurred image.

[**L6.E.2**] **Iterative solution:**

$$\hat{i}_{k+1} = \hat{i}_k + \lambda(g - \hat{i}_k * b) \tag{2}$$

Implement Eq.2 and deblur the above noisy blurred image. Show the following and implement it.

$$\hat{I}_k = \frac{G}{B}[1 - (1 - \lambda B)^{k+1}]. \tag{3}$$

Assignments

[**L6.A.1**] What is AWGN? Explain each term of the abbreviation in detail.

[**L6.A.2**] Describe atleast two comparative quality measures used in restoration except for PSNR. What is PSNR?

[**L6.A.3**] Suggest a kernel b for horizontal motion blur.

[**L6.A.4**] Simulate the blurring with gaussian 5×5 kernel and AWGN with variance of 5. Using the iterative procedure restore the original `image.jpg`.