博士班基本學科考試：數位影像處理

1. (20%)

   (i) What is full-scale histogram stretch? What is histogram equalization? Describe their difference.

   (ii) When we apply histogram equalization to the original image shown below, we will get the "Processed image 1" which seems not to be a good result. Explain the reason and describe how to have the better result like "Processed image 2."

| Original image | Processed image 1 | Processed image 2 |

2. (20%) What is alpha-trimmed mean filter? What is unsharp masking? Describe their usages and limitation.

3. (20%) When applying Fourier transform, sometimes we need to pad images by appending zeros to the end of rows and columns in the image (see the following image on the left). Do you think it would make a difference for spectrum if we centered the image and surrounded it by a border of zeros instead (see the following image on the right), but without changing the total number of zeros used? If you think there is difference, please explain the difference.

4. (20%) Suppose we know a certain X-ray imaging system produces a blurring degradation that can be modeled in the frequency domain by the following expression

$$H(u,v) = -\sqrt{2\pi}\sigma(u^2 + v^2)\, e^{-2\pi^2\sigma^2(u^2+v^2)}$$

Write down the expression for a Wiener filter, assuming that the ratio of power spectra of the noise and undegraded signal is a constant K.

5. (20%)

Consider the morphological operations for binary images. Prove the validity of the duality expression $(A \bullet B)^c = (A^c \circ \hat{B})$. (Notice: If you want to use the duality of dilation and erosion, you will have to write down its proof.)