LELE 5026 Digital Image Processing Lab.
Lab. 4
Image Enhancement in The Spatial Domain

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1. Objectives:

- Performing image enhancement using different type of intensity transformations
- Obtaining the histogram of an image.

2. Theory:

The first part of this experiment will deal with enhancement. The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. The enhancement approaches utilized in this experiment are used for the sake of general-purpose contrast manipulation. These approaches are referred to as point processing (because they manipulate still-pixel images). The general form of the enhancement approach is:

$$\boxed{\mathbf{S = T(r)}}$$

Where T is a transformation that maps a pixel value r into a pixel value s. the gray-level transformation which to be studied here are:

I. Image Negatives: assume the gray level range is [0, L-1]:

$$\boxed{\mathbf{S = L\text{-}1\text{-}r}}$$

- Useful for enhancing white and gray details embedded in black regions.

II. Log Transformations:

$$\boxed{\mathbf{S} = c\ \mathbf{log(1+r)}}$$

- Stretch low gray levels and compress high gray level.
- Useful for displaying spectral information.

III. Power-Law Transformations:

$$\boxed{\mathbf{S} = c\ \mathbf{r}^{\gamma}}$$

- $\gamma < 1$ ➔ T plays as log transformation.
- $\gamma > 1$ ➔ T plays as inverse log transformation.

The second part of this experiment will deal with the histogram of a digital image. For a gray-level image in the range [0, L-1], the histogram is a discrete function:

$$\boxed{h(r_k) = n_k}$$

where r_k is the kth gray level and n_k is the number of pixels in the image having level r_k. It is a common practice to normalize the histogram by dividing each of its values by the total number of pixels in the image, denoted by n. Thus a normalized histogram is given by:

$$\boxed{p(r_k) = n_k/n}$$

$p(r_k)$ gives an estimate of the probability of occurrence of a gray level r_k.

3. Experimental work:

1. Enhance the images of figures 1,2,3 using the three intensity transformations described above. Let c =1 always. Use different values of γ (0.6, 0.4, 0.3, 3.0, 1.0, 5.0) for each image.
2. Comment on the results you have got.
3. Compute and plot the histogram of the original and the enhanced imaged you got in section 1.
4. Comment on the results.

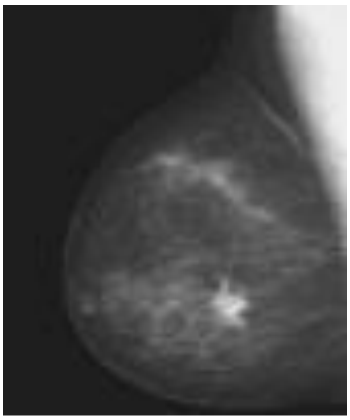

Figure 1

Figure 2

Figure 3

4. Appendix:

I. Image Negatives:

```
I=imread('image.jpg');
I=im2double(I);

for i=1:size(I,1)
    for j=1:size(I,2)
        I1(i,j)=1-I(i,j);
    end
end
subplot(211)
subimage(I)
title('original image')
subplot(212)
subimage(I1)
title('enhanced image (image negative)')
pause
close
```

II. Log Transformations:

```
 c=input('the value of the constant c= ');
 for i=1:size(I,1)
     for j=1:size(I,2)
         I2(i,j)=log10(1+I(i,j));
     end
 end
subplot(211), subimage(I),title('original image'),pause,
subplot(212), subimage(I2),title('enhanced image (log
transformation)')
 pause
 close
```

III. Power-Law Transformations:

```
 c=input('the value of the constant c=');
 g=input('the value of gamma g=');
 for i=1:size(I,1)
     for j=1:size(I,2)
         I3(i,j)=I(i,j)^g;
     end
 end
subplot(211), subimage(I),title('original image'),
subplot(212), subimage(I3),title('enhanced image (power-
low transformation)')
pause
close
```

IV. Histogram

```
 i=imread('Fig3_9_a.jpg');
 I=im2double(i);
 I=rgb2gray(I);
 p=linspace(0,1,256);
 Iv=reshape(I',1,size(I,1).*size(I,2));
 hist(Iv,p)
```