LAB LESSON FOUR

IMAGE ENHANCEMENT USING ARITHMETIC OPERATIONS

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Image Enhancement

The purpose of image enhancement is to improve the appearance of an image so that it looks subjectively better. Removing blurring noise, increasing contrast and revealing details are examples of enhancement operations (Rapp, 1996). One of the most basic ways to enhance an image in Matlab is to change its brightness and contrast. You can change these attributes by

- Stretching the color distribution
- Equalizing the distribution of colors to utilize the full range of colors
- Adjusting the scaling of the colors

Enhancement using Logical Operations

Function	Purpose
`~ (NOT)`	Performs negative transformation
`& (AND), | (OR)`	Masking, region of interest (ROI) processing
`xor`	Returns a 1 if both pixels are logically different, otherwise 0
`imcomplement`	Complements image

```
J=imread('minaret.bmp');
I=im2bw(J);
image(I); axis off;
disp('please select the Region Of Interest')
ROI = roipoly(I); figure, imshow(ROI);
K = and(I, ROI);
figure, imshow(K);
```

Enhancement using Image Arithmetic

A significant amount of image processing can be done with basic functions of arithmetic: addition, subtraction, multiplication, and division:

- With addition and multiplication, you can perform image contrasting and simple edge detection.
- With subtraction and division, you can perform simple motion detection (detecting the differences in one image to another).

The different functions that exist for image arithmetic are as follows.

Function	Purpose
`imabsdiff`	Compute absolute difference of two images
`imadd`	Add two images or add constant to image
`imdivide`	Divide two images or divide image by a constant
`imlincomb`	Compute linear combination of images

`immultiply`	Multiply two images or multiply image by constant
`imsubtract`	Subtract two images or subtract constant from image

Note With the introduction of integer mathematics in MATLAB, you can now use the arithmetic symbols (+,-,.*,./) instead of the imadd, imsubtract, immultiply, and imsubtract functions. However, the other arithmetic functions continue to be useful in the area of image processing.

Image Addition

Image addition makes it possible to superimpose an image on top of another or control the brightness of an image. Each resulting pixel is the sum of the respective pixels of the two images, of the same size and of the same class.

```
I1 = imread('peppers.png');
I2 = imadd(I1,50);
subplot(2,1,1), imshow(I1)
subplot(2,1,2), imshow(I2)
```

```
I = imread('rice.png');
J = imread('cameraman.tif');
K = imadd(I,J);
imshow(K);
```

Image Multiplication

By multiplying an image, you can change the brightness of an image. In this example we multiply the image by a factor of 1.2 to increase the brightness of the moon and to slightly accentuate the craters.

```
% image multiplication
I = imread('moon.tif');
J = immultiply(I,1.2);
subplot(1,2,1), imshow(I);
subplot(1,2,2), imshow(J);

J=imread('minaret.bmp');
I=rgb2gray(J);
image(I); axis off;
disp('please select the Region Of Interest')
ROI = roipoly(I); figure, imshow(ROI);
ROI = uint8(ROI);
K = immultiply(I, ROI);
figure, imshow(K);
```

Image Subtraction

One of the things that you can do with simple subtraction is to detect change from one image to another or to isolate objects.

```
% image subtraction
im1 = imread('change1.png');
im2 = imread('change2.png');

im_diff = imsubtract(im1,im2);
imshow(im_diff);
subplot(1,3,1), imshow(im1); title('Image 1');
subplot(1,3,2), imshow(im2); title('Image 2');
subplot(1,3,3), imshow(im_diff); title('Image
Difference');
```

Image Division

```
%divide
I = imread('rice.png');
J = imdivide(I,2);
subplot(1,2,1), imshow(I)
subplot(1,2,2), imshow(J)
```

References:

1. Rapp, C.S. & Joyner, W.L. 1996. Image processing and image enhancement. http://www.theaps.org/education/k12curric/activities/1996-Labs/rapp.pdf [25 Dec 2003].

2. Petrou, M. & Bosdogianni, P. 2003. *Image processing: The fundamentals.* Chichester: John Wiley & Sons Inc.

3. Umbaugh, S. 1999. *Computer vision and image processing.* Los Angeles: Prentice Hall Inc.

Assignment

1. Extract a coin from 'eight.tif' file.

(4 marks)

2. Show the difference between 'mask.jpg' and 'angio,jpg'. Enhance the result so that you can display it better.

(6 marks)