UNIVERSITY OF PITTSBURGH

Department of Electrical and Computer Engineering
ECE 1390 Introduction to Image Processing

Computer Project 1 (Fall 2017)

Assigned: Sept 18
Due: Oct 10
References: Secs. 1.1 to 1.5, 2.1 to 2.6, 3.1 and 3.2 (Gonzalez and Woods 3rd edition)

Problem 1.1 : Generating rectangular binary masks

a) Write a function in Matlab m=mask(M, N, rUL, cUL, rLR, cLR) for creating a binary mask of size $M \times N$ with 1's in the rectangular region defined by upper-left row and column coordinates (rUL, cUL), and lower-right coordinates (rLR, cLR), respectively. The rest of the $M \times N$ mask should be 0's. Your function should contain a check to make sure the specified region of 1's does not exceed the dimensions of the $M \times N$ region.
b) Read the image rose1024.tif and generate a square mask whose sides are one-half the size of the image in both directions. The mask should be centered on the image.
c) Apply your mask to image rose1024.tif and display your result.

Problem 1.2: Mask mode radiography

a) Write a function g=imArithmetic(f1, f2, op) for performing arithmetic operations as defined by op on grayscale images f1 and f2. Parameter op is a character string that indicates the following arithmetic operations between f1 and f2: "add", "subtract (f1-f2)" "multiply", and "divide (f1/f2)". These are elementwise operations. Note here that grayscale images are displayed usually using 8bits. Thus, we expect image values to be in the range from 0 to 255. For example, the values in the difference of two 8-bit images can range from a minimum of -255 to a maximum of 255, and the values of the sum of two such images can range from 0 to 510. Given a digital image g resulting from one or more arithmetic (or other) operations, an approach guaranteeing that the full range of values is captured into a fixed number of bits is as follows
$$g_m = g - \min(g)$$
which creates an image whose minimum value is 0. Then, we perform the operation
$$g_s = K \left[\frac{g_m}{\max(g_m)}\right]$$
which creates a scaled image g_s whose values are in the range [0,K]. When working with 8bit images setting K=255 gives us a scaled image whose intensities span the full 8bit scale from 0 to 255.
b) Mask mode radiography is based on subtracting a mask image from a live image. Read images angiography-live-image.tif and angiography-mask-image.tif and subtract the latter from the former using the function from 1.2 (a). Display the output image.

Problem 1.3: Image histograms and Histogram Equalization

a) Write a function h=imageHist(f, mode) for computing the histogram of a 256-level grayscale image f, whose intensity values are nonnegative. If mode= "n" , the histogram should be normalized (this is the default). Otherwise, if mode = “u”, the histogram should be unnormalized.

b) Generate and plot the histogram for rose1024.tif.
c) Given a grayscale image f, write a function [mean, variance]=meanVariance(f) that computes the mean and variance of the image f using the normalized histogram of the image f computed through the function written in 1.3 (a).
d) Compute the mean and variance of the image rose1024.tif
e) Repeat (b) and (d) for angiography-live-image.tif.
f) Write a function g=histEqual(f) for performing histogram equalization on 8bit input image f.
g) Histogram equalize the images rose1024.tif and angiography-live-image.tif.