



University of Tehran

School of Electrical and Computer Engineering



Digital Image Processing

Instructor: Hamid Soltanian-Zadeh

Assignment 1

Chapter 2 – Digital Image Fundamentals

Due Date: 10th of Esfand 1400

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Problem 1

In this problem, we have an example to get familiar with MATLAB for Digital Image Processing.

- a. Use `imread` function to read image "DIP.jpg".
- b. Use `imshow` function to show the image.
- c. Convert the image to gray scale using `rgb2gray` function and display the result.
- d. Convert the gray image you made in step "c" into double using `im2double` function and discuss the advantages of double format.
- e. Use `imwrite` function to save the image you made in step "e" in "tif" format.
- f. Magnify using `imresize` function and display the gray image by scales 2, 1/2, and 1/4, then discuss the effect of reducing spatial resolution.

Problem 2:

In this problem, we will try to get to know some affine transformations which are necessary steps for some image processing applications.

Load the image "T.tif" and apply all the transformations such as Scaling, Rotation, Translation, and Shear to it. use the Affine Matrices mentioned in Table 2.2 of the textbook. Set the parameters of each transformation by your own idea and report them clearly for each part. Display the results (you can use `imtransform` function).

Problem 3:

Load "skull.tif" image as you see this is a 256-intensity level image. Display the gray image in 64, 16, 4, and 2 intensity levels while keeping the image size constant. Discuss the effect of varying the number of intensity levels.

Problem 4:

In this problem, we will use arithmetic operations (read Section 2.6.3 in the textbook).

- a. The image "angiography_mask.tif" shows a mask X-ray image of the top of a patient's head prior to injection of iodine medium into the bloodstream, and "angiography_live.tif" is a sample of a live image taken after the medium was injected. Use subtraction to make blood vessel structures visible (note the intensity range of the resulting image).

- b. An important application of image multiplication (and division) is shading correction. "filament_shaded.tif" is a shaded image of a tungsten filament and "sensor_shading.tif" is the shading pattern. Correct the shaded image using shading pattern and display the result. Suppose that the shading pattern is unknown, but you have access to the imaging system, how can you obtain the shading pattern?

Problem 5:

Local averaging is a simple, intuitive, and easy way for smoothing images and often used to reduce the noise. The idea of local averaging is simply to replace each pixel value in an image with the mean value of its neighbors, including itself, like Figure 2.35 of the textbook.

- a. Write your own code to do local averaging on "char.tif" with a window size of 3_by_3.
b. Repeat " Part a" with different window sizes such as 9_by_9, 17_by_17, and 41_by_41.

Note: You **cannot use** MATLAB built-in functions.

Problem 6:

Interpolation is the process of using known data to estimate values at unknown locations. In this problem, we want to compare three different interpolation approaches used for image shrinking. Load the image "watch.tif", shrink the images by a factor of 5 (you can use imresize function) using nearest, bilinear, and bicubic interpolation techniques. Zoom the reduced image back to its original size and discuss their differences in terms of details.

Descriptive Assignments

Please solve the following questions of the 2nd Chapter of the textbook: 2, 5, 7, 9, 10, 21.

Notes:

1. Put written codes for each problem in one m-file, and for each section, intercept them by %%.
2. Analytical problems can be solved on papers, and there is no need to type the answers. The only thing that matters is the quality of your pictures. Scanning your answer sheets is recommended. If you are using your smartphones, you may use apps such as CamScanner or Google Drive Application.
3. Simulation problems need report as well as source code and results. This report must be prepared as a standard scientific report.
4. Your report is particularly important in the correction process. Please mention all the notes and assumptions you made for solving problems in your report.
5. You have to prepare your final report, including the analytical problems answer sheets and your simulation report in a single pdf file.
6. Finalized report and your source codes must be uploaded to the course page as a ".zip" or ".rar" file with the file name format as: Fullname_StudentNumber_HW#.rar.
7. **Plagiarisms will be strictly penalized.**
8. You may ask your questions from the corresponding TA of each assignment.