DIP Homework 1

1 Problems from the textbook: 2.10

2 Write a MATLAB code for zooming and shrinking an image by bilinear and bicubic interpolation. The input to your program is: (i) image, (ii) zooming/shrinking parameters along the image rows and columns, and (iii) interpolation method. Use the image "library.jpg" available on the class website as input. Your report should include:

2.1) M-file with a well-commented code;

2.2) Figure 1 showing the input image that is zoomed by 1.7 along rows and 2.4 along columns using: (a) bilinear interpolation, and (b) bicubic interpolation; The caption of Figures 1a and 1b.

2.3) Figure 2 showing the input image that is shrunk by 4.3 along rows and 3.6 along columns using: (a) bilinear interpolation, and (b) bicubic interpolation; The caption of Figures 2a and 2b.

(Hint: Use the following MATLAB commands: 'imread', 'imshow', 'imwrite', 'meshgrid', 'interp2')

3 Write a MATLAB code for computing an affine transform of an image. The input to your program is: (i) image, (ii) parameters of the affine transform, and (iii) interpolation method. Your report should include:

3.1) M-file with a well commented code;

3.2) Figure 3 and the caption: As input, use the image "Lecture Hall.jpg" that is available on the class website. Rotate this image by 45 degrees counter-clockwise, and display the result using the bilinear interpolation. The rotation should be implemented by using the following spatial transform:

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = T_{rotation} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

3.3) Figure 4 and the caption: As input, use the image "library.jpg" that is available on the class website. Transform this image by using the following spatial transform and bilinear interpolation:

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = T \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

where

$$T = \begin{bmatrix} 0.3 & 0.1 & 0 \\ 0.5 & 0.9 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

3.4) Figure 5 and the caption: As input, use the image generated in Figure 4. Apply

the inverse spatial transform T^{-1} to Figure 4, and display the result using the bilinear interpolation.

3.5) Figure 6 and the caption: Subtract Figure 5 from the original image (apply zero padding if the images have different sizes); In the caption, explain why Figure 5 is different from the original image.

(Hint: Use the following MATLAB commands: 'maketform', 'imtransform')

4 Problems from the textbook:

4.1) 3.7

4.2) 3.8

4.3) 3.11

5 Nighttime Road Contrast Enhancement

The visibility of lane markings, road signs, and obstacles on the roads is significantly reduced at nighttime. To assist drivers in dark conditions, we can perform contrast enhancement on images captured by the car's front-facing camera and display the enhanced images to the driver. On the handouts webpage, you can find three images captured at different times on different roads: hw1_dark_road_1.jpg, hw1_dark_road_2.jpg, and hw1_dark_road_3.jpg.

For each image, please perform the following operations and submit the required results.

(a) Plot and submit the histogram (MATLAB function: imhist) of the original image's grayscale values. Briefly comment on the shape of each histogram.

(b) Apply global histogram equalization to the original image (MATLAB function: histeq). Display and submit the modified image. Plot and submit the histogram of the modified image's grayscale values. Comment on visually desirable/undesirable regions in the modified image.

(c) Apply locally adaptive histogram equalization to the original image (MATLAB function: adapthisteq). Display and submit the modified image. Plot and submit the histogram of the modified image's grayscale values. Choose and report the number of tiles and the clipping limit for attaining higher contrast while avoiding the generation of noisy regions and the amplification of nonuniform lighting effects. Comment on the subjective quality of the modified image compared to the result in (b).

Note: Please include relevant MATLAB code.

IMPORTANT: In your report, all figures must have captions.

Instructions for turning in the homework:

Submit your PDF report named **studentnumber_hw1.pdf** via course web.