E9 241: Digital Image Processing (2018)

Assignment 2

(marks-100)

Due Date: November 19, 2020

Note: For the questions assigned below you have to write your own function. In-built function can be only used to validate your result. Submit a separate text/pdf file containing the answers to the observation-based questions asked.

1. **Point Operations:** Write codes to do the following:

   a) **Linear Contrast Stretching:** Enhance the images *LowLight_1.png* and *LowLight_2.png* by amplifying the pixels using an appropriate gain value. (Gain value has to be chosen such that the pixel values do not saturate beyond 255). Does it work well for both the images? If not, why? **(10)**

   b) **Power Law Contrast Stretching:** Now process the images *LowLight_1.png*, *LowLight_2.png* and *Hazy.png* by exponentiation of the given images by a suitable exponent value (It might be convenient to operate on images with pixel values normalized to the range [0,1]). Did it overcome the limitation of linear contrast stretching? If yes, then why? **(10)**

   c) **Histogram Equalization:** Enhance the images *LowLight_2.png, Hazy.png, StoneFace.png* and *LowLight_3.png* by equalizing their histograms. What all issues do you notice in the enhanced images? How does the enhanced version of *LowLight_3.png* look? Plot the histograms of the images and note how is the histogram of *LowLight_3.png* different from those of other images. Can you now argue as to why the enhanced version of *LowLight_3.png* looks the way it looks? (Note: Do not perform full scale contrast stretch as part of histogram equalization) **(10)**

   d) Contrast limited Histogram Equalization (CLAHE): Divide the *StoneFace.png* image into 8x8 non-overlapping blocks (eg. For an 80x80 image there are 64 10x10 non-overlapping patches). Perform contrast limited histogram equalization on each block. Choose appropriate clipping thresholds. What observations can you make about visibility of the image obtained by this method with that of part (c). Also divide the image into 8x8 blocks with 25% overlap in both directions. Average the transformed intensities if a pixel belongs multiple overlapping blocks. Compare in terms of visibility, the difference between overlapping and non-overlapping CLAHE method. **(20)**

2. **Saturated Contrast Stretching:** In this method the histogram of each R,G,B channel is stretched to the range of 0-255. To achieve this, assign a certain percentage of brightest pixels to 255 and certain percentage of darkest pixels to 0. Then perform linear contrast

stretching as in 1(a) on the remaining pixels image. Consider the image '*MathBooks.png*' for this problem. Compare the histogram of that stretched image obtained in this method with that of histogram obtained by applying linear contrast stretch.
(20)

3. **Resizing an image:** Write a function resize.m (or resize.py) that accepts a grayscale image, resizing factor and a string ('nearest' for Nearest Neighbour interpolation and 'bilinear' for bilinear interpolation) as input and returns the resized image. Which interpolation method gives better results visually. Note that the resizing factor can either make an image larger or smaller. The resizing factor need not be an integer. **(15)**

4. **Image Rotation:** Write a function ImgRotate.m (or ImgRotate.py) that accepts an image, degree of rotation (in the counter clockwise direction with respect to the x-axis) and a string ('nearest' for Nearest Neighbour interpolation and 'bilinear' for bilinear interpolation) as input and returns the rotated image. **(15)**