

## Digital Image Processing (ECE513)

### Computer Project 3: Image Enhancement (Due April 16<sup>th</sup>, 2020)

The goal of this computer assignment is study the effects of various point and spatial operators for contrast enhancement, noise removal, edge extraction and sharpening. Use the images on the course website.

1. **Contrast Enhancement:** In this part, we design histogram manipulation schemes to improve the contrast and visual appearance of the “Pepsi” image. An important design consideration is that the desired properties of different objects in the images are not adversely affected. First, try histogram equalization with different number of bins and compare the results and effects on the histogram. Devise a “desired histogram” taking into account the above-mentioned requirement and apply specification algorithm. Compare the resultant image and its histogram with those of the histogram equalization and comment on their contrast enhancement abilities and shortfalls. Explain how you arrived at your final desired histogram. MATLAB functions for this part are: `imread`, `imshow`, `imhist`, `histeq`.
  2. **Spatial Filtering:** Use function “`imnoise`” to generate a noisy version of the “Lena” image by adding white Gaussian noise with SNR=5dB. This image should then be used as the input to all the filters in this part of the computer assignment. Using “`conv2`” apply various 2D low-pass filtering masks of different sizes (see Lecture 19) and coefficients to remove the effects of the additive noise from the noisy image. Compare the results of at least two filters in terms of SNR improvements and comment on their frequency selectivity characteristics using their frequency responses (function `freqz2`).
  3. **Median Filtering:** Using the same “`imnoise`” function, add “salt and pepper” noise to “Lena” image. Then apply median filters of sizes 3x3, 5x5 and 7x7 using the function “`medfilt2`” to this noisy image. Increase the level of noise and determine experimentally the maximum noise level that can be tolerated without producing considerable blurring artifacts.
  4. **Edge Sharpening:** Apply two different edge extraction masks covered in Lecture 20, using function “`edge`” to sharpen the edges and improve the visual appearance of the “Boat” image. Make sure edge saturation does not occur by properly selecting the value of  $\lambda$ . Compare the results of these algorithms in terms of visual appearance.
1. Provide a detailed discussion on the effectiveness of these methods for image enhancement in a report. **Please carefully read the guidelines for preparing your report.**