Semester I, 2019 – 2020 October 19, 2019

CS517: Digital Image Analysis

Midterm Lab Test

Question 1 (Q1.m): **[20 Points]**

The P-Median filter is designed to suppress noise while preserving edge and line details. The filter calculates median values for two subsets of values in the filter window:

- Combined horizontal and vertical transects through the center cell
- Two diagonal transects through the center cell

These two median values are then averaged. The output of the filter is a weighted average of the averaged median and the original center cell value. The weighting is controlled by filter parameter α, which can vary in value from 0 to 1. The value of 0.20 for parameter α in this exercise means that the original input value contributes 20% to the output cell value, and the averaged median value contributes 80%. Decreasing the value of parameter α will increase the degree of noise removal, at the expense of increasing degradation of edges and line features.

Provide an implementation of the P-Median Filter (`PMedian.m`) as:

- `[outImg] = PMedian( inImg, wSize, alpha )`

Where:

`inImg` – Input Image, `outImg` – Output Image, `wSize` – Window Size & `alpha` – weighting parameter

- `Q1.m` when run should display the original image (`Sattelite.jpg`), simple Median filtered image, P-Median Filtered Image (3 x 3, alpha = 0.5) and P-Median filtered image (5 x 5, alpha = 0.2) with appropriate titles.
- Comment on your observations in the README file.

Question 2 (Q2.m): **[10 Points]**

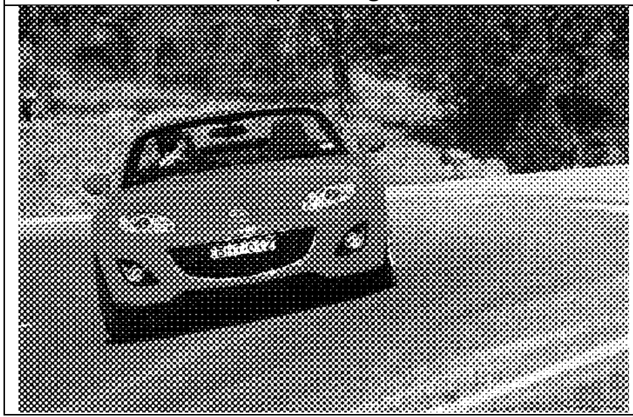
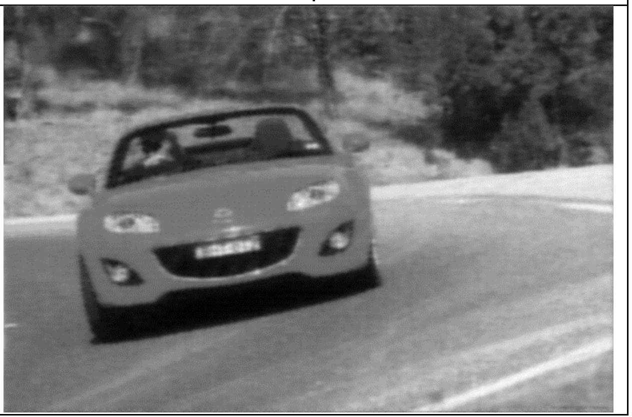
Generate a 512-by-512 image which contains a 40-by-80 rectangle placed at the center of the image. Set the background to black and the interior and the boundary of the rectangle to white. Rotate the original image by 45°.

- `Q2.m` when run should display the original image, the rotated image, and their Fourier transforms (with necessary formatting!) in with the appropriate titles.
- Explain the property illustrated in this example in the README file.

Question 3 (Q3.m): **[20 Points]**

Use MATLAB's inbuilt NOTCH filters to remove periodic noise from the image '`halftone.png`'

- `Q3.m` when run should output a figure with Input Image, Output Image and their corresponding Fourier Transforms (with necessary formatting!) with appropriate titles.
- Provide the details/specifications of the Notch filters in the README file.

Input Image	Output
	

Hint: You will need a SET of notch filters!

Question 4 (`Q4.m`): **[20 Points]**

Given an input image f, implement an appropriate sized, real, symmetric filter in frequency domain, H, as (`FreqFilter.m`):

$$H(u,v) = (b + 2cos(2\pi\frac{u-\frac{P}{2}}{P}))(b + 2cos(2\pi\frac{v-\frac{Q}{2}}{Q}))/(2+b)^2$$

Hint: Commands `meshgrid` and/or `freqspace` might be helpful!

- `Q4.m` when run should output a figure with Input Image (`lena512.bmp`), filtered Image and their corresponding Fourier Transforms (with necessary formatting!) with appropriate titles.
- Comment on your observations in the README file.

Submitting your work:

- 10 Points for clean code and comments; Total: 80 Points
- All source files and class files as one tar-gzipped archive.
  - When unzipped, it should create a directory with your ID. Example: **P2008CS1001–MT**
  - ***Negative marks if the TA has to manually change this to run his/her scripts!!***
- Source / class files should include the following: (Case-Sensitive file names!!)
  - `Q1.m, Q2.m, Q3.m, Q4.m`
  - `PMedian.m & FreqFilter.m`
- ***Negative marks for any problems/errors in running your programs***
- Submit/Upload it to Moodle