CAP 5400 – DIGITAL IMAGE PROCESSING

Assignment 3. The purpose of this homework is to experiment with Fourier Transform and frequency filtering [10 points]

- Your program should be able to apply F.T. to an ROI in the image (up to 3 ROIs). No need to implement D.F.T., use OpenCV the library that you have used previously. You will need to display the absolute value of the Fourier domain's amplitude as an image (be careful with needed scaling and center location).
  Limit your processing to square ROIs of size 2^p. Your program should be able to apply inverse D.F.T. and display the resulting image. This should work on grey-level images.
  NOTE: OpenCV is just to be utilized for D.F.T. only, you do all the filtering in C++. NOTE: within each ROI any filter operations can be performed

- Your program should
  - operate within each of the specified ROIs, the rest of the image should not be affected (three ROIs required to be implemented, same as in previous assignments)
  - apply D.F.T. to each ROI and display the absolute value of the amplitude of the Fourier domain before and after the filtering operation
  - apply inverse D.F.T. and display the resulting (combined) image.

- [4 points] Add low-pass and high-pass filtering to your choice of options. Assume a circular filter and allow the user to input one cut-off frequency (F) for low-pass/high-pass (filter does not affect the phase).

- [4 points] Add edge sharpening capability via "unsharp masking" by increasing high-frequency components (F) via multiplication in the frequency domain by the user-provided constant parameter (T).

- [2 points] Augmentation of grey level images: generate 11 additional similar same-size images from each ROI via

  a. Take the original ROI image and rotate 90, 180, and 270 degrees.
  b. Take the original ROI image and low-pass it with parameter (F). Then rotate by 90,180, 270.
  c. Take the original ROI image and perform unsharp masking (F, T)., then rotate 90/180/270.
  d. Display all 12 images.

-

- EXTRA CREDIT (4 points)

  - Implement a band-stop filter via a combination of low-pass and high-pass.[1 point]

  - Utilize image filtering on the V component of HSV color space (use OpenCV for conversion) and show results on color (RGB) output. Try low-pass, high-pass, and band-stop. [2 points]

  - Try filtering the H component, what does it do? Try filtering the S component. [1 point]

Write a report for this assignment [1 point]

- It should include input and output images.
- Experiment with low-pass and high-pass filtering and discuss your results.
- Compare low-pass filtering with regular smoothing, demonstrate on images.
- Compare high-pass filtering with expected performance of an edge detector, demonstrated on images.
- Discuss performance of image sharpening.
- Discuss color image filtering (extra credit)

How to submit

- See Canvas TA help desk for instruction on report and program submission and testing.