EECS 225B Problem Set 9

Due on 05/04/2020 at 9am on Gradescope

In this assignment, you explore the possibility of reconstructing an image from its Fourier transform phase. Please note there's an associated reading, found here.

Problem 1: Phase-only Reconstruction

Phase.dat which contains samples of the phase information of an image, stored in matrix form. The original image was 96 pixels wide and 64 pixels tall. The phase matrix contains 192 by 128 evenly spaced complex-valued samples of the discrete space Fourier transform (DSFT). The magnitude of each sample is normalized to one.

(1,1) of the matrix corresponds to $\omega_x = 0$ and $\omega_y = 0$

(*row*, *col*) corresponds to $\omega_x = 2\pi\,(col - 1)\,/\,width$ and $\omega_y = 2\pi\,(row - 1)\,/\,height$

Remember, in MATLAB, indices start with 1 and the row value (*y*) is listed before the column value (*x*). Implement the phase-only reconstruction algorithm described in Figure 1.30 (see the associated reading), and do your best to reconstruct the original image.

The algorithm in the book is described in terms of the DSFT and continuous ω_x, ω_y. In this lab you are working with samples of the DSFT, and 2-D discrete Fourier transforms (2D-DFT).

The iterative procedure requires an initial guess. How does your initial guess affect the algorithm? What did you choose for an initial guess? Why?

The iterative procedure also requires a termination condition. The algorithm in the book requires the phase of the reconstructed image to be equal to the phase given to you. This is not entirely practical from an implementation point of view. What termination criterion did you choose? Why?

Problem 2: Magnitude-only Reconstruction

There is another file Magnitude.dat which contains samples of the DSFT of a different image, with the phase information removed. Modify the iterative procedure to do magnitude-only reconstruction, and test it on this file. How well does it work?

Note:

1. For each problem, you need to:
    1. Email your source code (zip it before you email) to eecs225bsp20@gmail.com if the question asks for any implementations.
        1. Make sure your code is executable. Either MATLAB or Python is okay. Please avoid C/C++ if possible (appreciate it!). If using Python, Jupyter Notebooks are preferred.
        2. Email title: FirstName_LastName_HW#. For example, Scott_McCrae_HW1.
        3. Submit a single PDF file on Gradescope which contains: i. your answer for each problem; ii. your source code (please also paste your source code here; screenshots are okay); iii. your output image(s). Make sure to prepare your solution to each problem on a separate page. On Gradescope, please select and match each page to the corresponding problems.
2. Remember to follow the course homework policies on collaboration. You're allowed to collaborate with other students on homework, but each student needs to write up their own original solutions. **Please do not submit the exact same writeup or code, as this is considered academic dishonesty. Copying solutions from any source is considered academic dishonesty.**